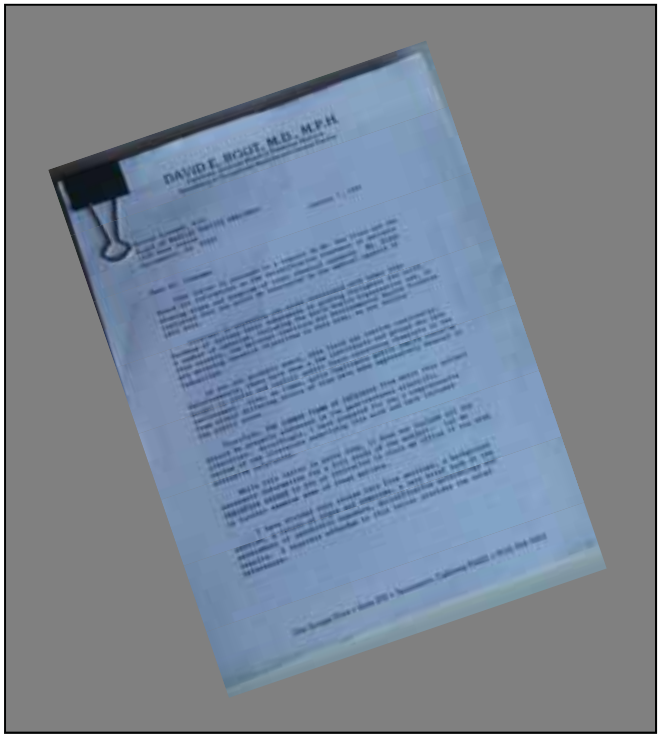
DETOXINATION
WELLNESS CENTERS

SCIENTIFIC REVIEW

OF

SAUNA DETOXIFICATION THERAPY

Presented by David E. Root, M.D., M.P.H. in 1987 to the California Medical Board / Board of Quality Assurance



This complete 50 page report, including 23 pages of references, provides the scientific efficacy behind the sauna detoxification therapy Dr. Root has personally administered to over 4,000 patients and supervised, or otherwise consulted on, the treatment of thousands more around the world since 1982.

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Harold Schwamb, M.D.
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1430 Howe Avenue
Sacramento, CA 95825

January 7, 1987

Dear Dr. Schwamb:

This letter is pursuant to a request by Mr. Ron Olson and the Board for information on the detoxification treatment of patients showing signs and symptoms of toxic chemical exposure. Mr. Olson indicated that you would be interested in the medical aspects of this work.

Interest in assessing the risks associated with human body burdens of various toxic substances is growing throughout the world. A number of agencies, including the World Health Organization and, in this country, the National Institute for Environmental Health Sciences are pursuing research objectives in this area, as are various industries.

As you are probably aware, this field can involve controversy. Unfortunately, there have been a few individuals and groups who have sought to incite and exploit public fears concerning chemicals in the environment. Also, at times, quite legitimate public health concerns from widely differing points of view have been aggressively debated in the public arena.

Therefore, the common frame of reference from which this subject should be properly addressed is the peer-reviewed scientific literature. Accordingly, I have prepared for you a comprehensive review of the literature underlying this work and have included extensive references.

While this letter is quite long, it does not include all the necessary information for a full study of the subject. Let me therefore extend to you an invitation to visit my office if you wish to further examine some of these matters.

I have divided this review into five sections, a background section, a review of signs and symptoms, a very brief look at the assessment of xenobiotic exposure, detoxification methodology and results. A separate addendum to this letter provides the noted references.

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I. HUMAN CONTAMINATION

Concern about the storage of hazardous chemicals within the human body dates back several centuries and was formally examined as early as the 18th century by Ramazzini in his work on occupational diseases (1).

From that time forward, exposure to chemicals has increased with an ever quickening pace. The largest expansion in the chemical revolution took place after World War II with a dramatic growth in the number and variety of hazardous chemicals which store in human tissues. As of 1980 over 400 chemicals had been identified in human tissue, some 48 in adipose tissue (2).

The explosive post-war proliferation of toxic chemicals has left behind an enormous void of information on these substances, a vacuum which will require decades and tremendous human and financial resources to fill. The National Research Council reported in 1984 that almost no toxicity data is available for about 80% of the 50,000 odd chemicals now used commercially (3).

This dearth of reliable data has in some instances placed the debate over the extent and significance of industrial and environmental chemical exposures on an emotional, rather than a scientific, footing. Charges and counter-charges are often exchanged in the absence of sound scientific investigation. While current legitimate public health concerns must be addressed, one must be mindful of the potential for the fraudulent exploitation of the public's fear of contaminants.

Nevertheless, the potential health hazards associated with human body burdens of toxic chemicals are of increasing concern to private and governmental investigators throughout the world. The National Institute for Environmental Health Sciences, for example, has included among its research priorities the development of alternative designs for the standard cancer bioassay in order to make the end results more amenable to low-dose extrapolation. NIEHS has also called for the study of the metabolism and storage of PBB (polybrominated biphenyls) and possible means of reducing PBB body burdens (4).

Human xenobiotic contamination takes place in many ways. There are exposures like the one in Michigan where people were contaminated by PBB through the dairy and beef food chain (5). These types of exposures affect large populations and have occurred in many nations. Their stories are legend in the environmental community and include dioxin in Seveso, Italy, PCB's in Japan and Taiwan, methyl isocyanate

in Bhopal, India, and HCB's in Turkey (6-10). Taken together, over ten million people have been exposed around the world by these five incidents alone.

Accidental exposures also occur on a more narrow plane. A transformer may explode, exposing one or more persons to high concentrations of PCB's. Isolated industrial accidents may also bring about high body burdens of persistent toxicants.

Other forms of exposure are more pedestrian. In everyday life, workers and many others are routinely exposed to toxic substances. Whether it is caused by an overly zealous pesticide applicator, the inhalation of gasoline fumes containing benzene and lead or chronic occupational exposures, contamination by toxic substances is a common occurrence in modern society. Even infants receive a chemical legacy from their mothers during gestation as well as while feeding at their breasts (11,12). The practical result of these common low level exposures is increases in human body burdens with age, because many chemicals accumulate in bone and fat much more rapidly than the body can excrete them.

Substance Abuse

The abuse of drugs and medicines provides yet another source of increasing xenobiotic body burdens. Based upon statistics compiled by the National Institute on Drug Abuse (13), over 50 million people in the nation have used such fat-soluble drugs as cocaine, phencyclidine (the street drug called PCP or angel dust), diazepam or THC, the major active chemical in marijuana. As might be expected, standard analytical methods are now being developed to accurately determine adipose tissue levels of these substances in humans. Even now, however, there are a great many studies which suggest that these drugs do store for prolonged periods.

A. Cocaine

With regard to cocaine, Nayak (14) deduced that the binding of lipophilic cocaine to tissue may play a more important role in determining its overall pharmacokinetics than its plasma protein binding capacity. Comparing acutely and chronically exposed rats, Nayak (14) has shown that cocaine concentrations from six hours to four weeks after injection were much higher in fat than concentrations in other tissues of chronically treated animals.

Norcocaine, another cocaine metabolite, was observed in rat brain (16). It has been shown to be a pharmacologically active metabolite of cocaine in the brain of dogs,(15) monkeys (17), and rats (16) and is oxidized to its highly reactive nitroxide free radical. This, in conjunction with the prolonged storage of cocaine in the fat of the chronically exposed, may explain the systemic toxicity of cocaine.

When combined with an understanding of the potential for mobilization of fat stored chemicals, this animal data suggests that the sequestration of cocaine and metabolites in fat depots of the chronically exposed individual can be expected to produce a slow prolonged release of cocaine into the plasma long after discontinuation of drug use. The result is the potential for long-term unpredictable adverse effects in humans due to either slow or rapid releases of fat stored residuals.

B. Diazepam

In studying Diazepam (DZ), DeSilva (19) found that single oral doses of DZ produced low and rapidly declining DZ blood levels. Repeated doses caused a progressive increase of DZ levels. The major metabolite of DZ, N-desmethyldiazepam (DMDZ) (18), appeared 24-36 hours after the first dose and thereafter the levels increased rapidly, approaching those of DZ levels. Upon discontinuing the drug, DZ and DMDZ disappeared from the blood very slowly, detectable levels of DMDZ persisting longer than DZ.

Those blood level fall-off patterns indicate a rapid and extensive uptake by tissues, followed by slow redistribution in the blood of DZ and DMDZ. As it is highly lipophilic, DZ is likely to be stored in adipose tissue, being released during lipolysis or under other conditions which promote mobilization. In addition, DZ was found in high concentrations in the fat of rats two hours after I.P. doses of 0.6 mg/kg (20). Marcucci (21) stated that it was clear from the results in his study that DZ accumulates in the adipose tissue in relatively high concentrations in mice, rats and man.

C. Phencyclidine

With regard to phencyclidine, James (22) concluded that tissue distribution of phencyclidine in the rat correlated well with its high lipid solubility. The drug shows a strong affinity for adipose tissue, and high levels persist long after the drug has cleared from the blood.

Misra (23) demonstrated the persistence of PCP and its metabolites for prolonged periods in brain and adipose tissue of rats. Due to the high lipid solubility of PCP, its tissue levels greatly exceeded the plasma levels.

In Martin's study on mice (24), three days after PCP administration the only detectable levels of PCP were in fat. Chronic exposure resulted in elevated levels of PCP in fat up to 21 days.

Misra feels that "the long sojourn of PCP in the adipose tissue and relatively slow egress therefrom explains cumulative effects upon multiple dosing and raises the possibility of the mobilization or release of large amounts of the drug from fat stores in situations involving food deprivation, marked weight loss or stress" (23).

D. Tetrahydrocannabinol

The plant Cannabis Sativa, from which marijuana is derived, contains at least 421 individual components, of which 61 are specific to cannabis. Ten are now routinely quantified when identifying cannabis samples (25).

Several animal studies document long-term storage of cannabinoids in fat and lipid containing tissues after Delta-8 and Delta-9-Tetrahydrocannabinol (THC) administration (26-30).

Kennedy (27), using the whole body autoradiography of the pregnant mouse and administration of labelled THC, found high concentrations of radioactivity in fat and a few organs. Kreuz (28) reported a ten-fold greater THC accumulation in fat of rats compared with other tissues. And Agurele (31), studying the metabolism of labelled THC in rabbits, found high levels of radioactivity in the fat of the rabbit three days after administration. As might be expected, repeated doses of THC lead to accumulation in fat (28). At least one study has documented the presence of THC in human adipose tissue (32).

The Significance of Human Contamination

If harmful fat-soluble chemicals moved into the major fat stores of the body and remained in place, perhaps there would be less cause to worry about human body burdens. However, these chemicals do not stay put, nor do they go only to relatively unimportant fat deposits.

Whenever lipids move into the blood, so too do the chemicals stored in them (33). This occurs every day as part of the normal functioning of the body. For example, the evening fast (while sleeping at night), aerobic exercise, and common emotional stress mobilize fat and hence stored chemicals (34,35,36).

Once in the blood these chemicals have the opportunity to reach every part of the body. For some chemicals this means they will be broken down into components, for example, by reaction in the liver. The components may go back to the fat or, if they are water soluble, may be excreted. However, many of the chemicals industry has created do not metabolize easily. They were developed so that they would not break down.

A good example are the polychlorinated biphenyls (PCB's). These chemicals were made for use in high temperature environments and withstand even moderately hot fires. In 1968, an outbreak of an epidemic occurred in Yusho, Japan that was traced to the contamination of cooking oil by PCB's. This material has been shown to store in body fat. Under normal conditions, very little, if any, of this material is excreted.

Complaints of PCB intoxication are usually reported as fatigue, headache and digestive disorders. Women occasionally complain of menstrual disorders. There may be a productive cough and some numbness in the extremities (37). Abnormalities in babies from mothers exposed to PCB from Yusho oil during pregnancy have been widely reported (38).

The clinical features were dark brown pigmentation of mucus membranes and skin, gingival hyperplasia with pigmentation, a tendency for babies to be born small for their due date, eruption of teeth at birth, hypersecretion of the meibomian gland and edema of the orbital area. Babies continued to be born with these features for some time after the exposure demonstrating that the developing fetus is a major excretory pathway for women of childbearing age.

Animal experimentation demonstrated that the principal areas affected by long term exposure to PCB's at low levels are the lymphatic system, liver and gastrointestinal tract (39).

It has subsequently been shown that people with high level exposure to PCB's have clinically identifiable effects related to their immune system (40).

The body is equipped to excrete water soluble chemicals, but is not as well developed to excrete the fat soluble ones. Therefore, if the body cannot break these chemicals down into excretable metabolites, they tend to redistribute into the various fatty portions

of the body. In addition to the adipose tissue lying just below the skin layers of the body, the brain, the sheathing of the nervous system, and the liver are also major fat depots. Persistent human contaminants are routinely found in these depots (2). Distribution is fairly even; recent studies by Ryan, et al, as well as the Centers for Disease Control, of cadaver burdens of 2,3,7,8-TCDD (dioxin) found comparable levels in each of the adipose depots examined with the exception of heart adipose tissue, where levels were lower (41,42).

The effects from chemicals which store in the body are not always easy to describe. First, there is inadequate health data on the vast majority of the 50,000 chemicals in commercial production (3). What data does exist tends to reflect effects in rodents rather than humans, and is nearly always the result of large exposures to a single chemical. It is difficult, if not impossible, to estimate the effects of chemical mixtures, and there have been very few such tests in animals. In addition, animal tests are notoriously poor at indicating the potential for effect on the skin or the nervous system.

There are also a number of individual and environmental variables which modulate the effects of xenobiotic contamination in humans. Individual variables include:

* Genetic susceptibility or predisposition (43)
* Age (44,45)
* Nutritional status (46,47)
* Lifestyle habits, such as alcohol and cigarette consumption (48-52)
* Biochemical uniqueness as it relates to the efficiency of metabolic pathways for absorption, uptake into tissues and excretion, and the degree of affinity of certain target tissues for xenobiotics in the body (53)
* The presence and degree of psychosocial stresses (54)
* The absense or presence of pre-existing disease.

Environmental variables include:

* Degree of exposure
* Duration of exposure
* The specific chemicals entering the body
* The interreactions of chemicals inside the body (55):
  Synergistic (combined effect greater than the sum of the effects of the individual agents);
  Potentiating (one component enhancing the effects of another);
  Additive (combined effect is the sum of the effects of the individual agents);
  Antagonistic (combined effect is less than the sum of the effects of the individual agents).
* The latent period between exposure and effect (56).

The basis for most human data comes from study of populations exposed in the work place or in large scale exposures such as those previously mentioned. There are usually a wide number of effects, some which may be unique to the chemicals in question, but most of which certainly are not.

Health effects associated with chemical exposure are characterized by a hierarchy of events. Figure 1, developed by Colucci, indicates the relative frequency of the different health effects associated with chemical exposure (57). This scale of effect severity is continuous up to the point of death. Morbidities are usually defined by clinical and sub-clinical signs. These are changes at the system level, the organ level, or the cellular level. They are generally measurable quantitatively, but may be directly observable by a clinician in a qualitative manner.

Morbidity due to chemical body burdens may take the form, for example, of increased blood pressure, decreases in numbers of red blood cells, increases in white blood cells, increases in specific enzymes, decreases in the rate of nerve impulse transmission, rashes, joint swelling and pain, IQ and personality trait change, and a myriad of other clearly observable effects, all considered adverse.

Below morbidity are the subtle effects of chemical exposure. Over a decade ago Golberg defined the study of these effects as "subliminal toxicology" (58). More often than not, these effects are observable as subtle functional changes such as slowing of motor reactions, impaired regulation of appetite, reduced visual discrimination capacities, fatigue, and memory loss. Mello reports that "the early and incipient stages of (these) intoxications are marked by vagueness and ambiguity" (59). These symptoms pose a special problem for health professionals. Weiss and Simon point out, "these are not deficits that induce people to seek out physicians" (60).

The significance of chemical exposure is not that low level exposures can cause subtle symptoms. Rather it is that such symptoms are the sentinels of possibly more serious chemical-related disease. Underlying toxicology research is the time tested model of biological action which suggests that the greater the chemical exposure, the greater the resultant effect. This model has been found to hold true for chemical health threats such as those now found in environmental and occupational settings. In the most common cases of chronic intoxication, clinical tests are frequently negative, despite the clear and plainly undesirable symptomatology (61). However, as body burdens rise, so too do concentrations in the blood, and resulting exposures in vital organ systems.

It comes as little suprise, therefore, to find a progression to more serious disease states with increasing body burdens. Figure 2 presents this progression in humans exposed to polychlorinated and polybrominated biphenyls (PCB's & PBB's).

The significance of increasing chemical body burdens comes from the increased probability of chronic disease, whether subtle or acutely manifest.

FIGURE I

Spectrum of Biological Response to Pollutant Exposure (57)

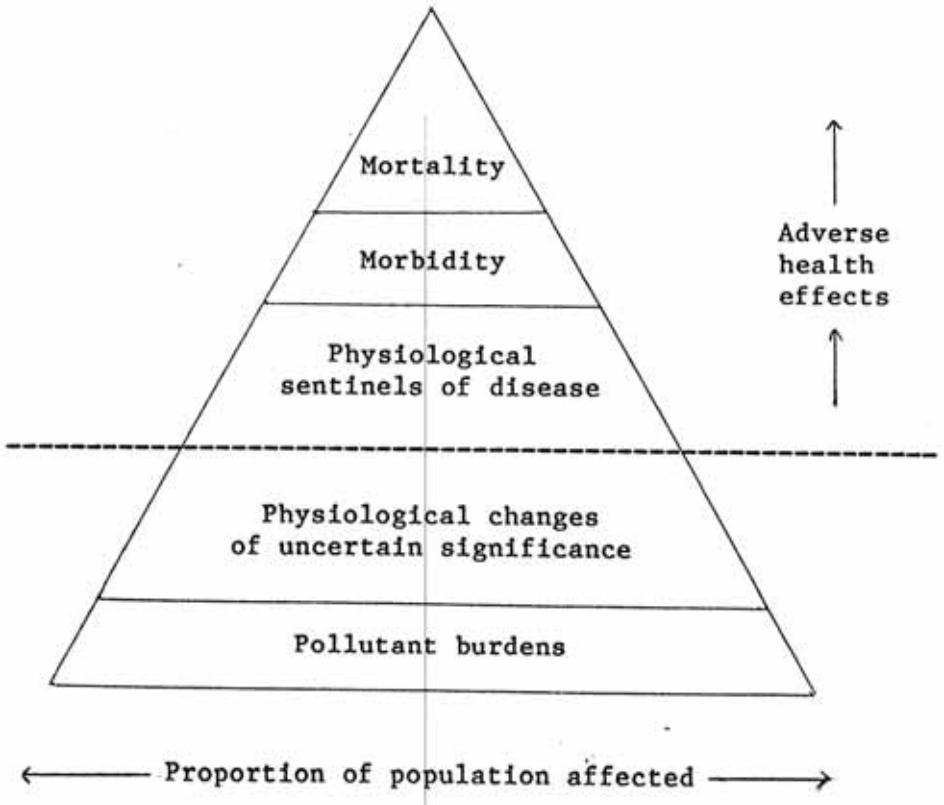

Figure II
The Progression of Disease Associated with
Bioaccumulation of Polyhalogenated Biphenyls

EXPOSURE	BIOACCUMULATION*		HEALTH INDICATORS	BIOLOGICAL RESPONSE
Ambient 35 yrs	.03 ppb blood PBB	(73)	None Observed	Normal
	.004 ppm fat PBB	(80)		
	2.3 ppb blood PCB	(107)		
Low-level or Ambient 35 yrs	11 ppb blood PBB	(64)	Subtle Symptoms	Fatigue (64,79) Headache Muscle weakness Nervousness Joint pain (See Table of Symptoms)
	.4 ppm fat PBB	(137)		
	5 ppb blood PCB	(115,125)		
Occupational or Extended Low-level	90 ppb blood PBB	(62)	Subclinical and Clinical Signs	Immune dysfunction (64) Elevated CEA titer (62) Elevated SGOT-SGPT (64,70)
	25 ppm fat PBB	(137)		
	44 ppb blood PCB	(79)		
Extended Occupational	603 ppb blood PBB	(136)	Overt Signs and Symptoms	Dermal (79,107) abnormalities Abdominal pain Eye irritation
	196 ppm fat PBB	(136)		
	356 ppb blood PCB	(107)		
Massive	13-75 ppm fat PCB	(84)	Premature Death	Major systemic failures (84)
Lifelong Ambient Exposure	8.7 ppm fat PCB	(124)	Premature Death	Cancer (124)
	5.1 ppm fat DDT			

* Fat concentrations measured on a per lipid weight basis

II. SIGNS AND SYMPTOMS

From a review of the literature, one can tabulate a pattern of signs and symptoms associated with xenobiotic contamination (63-143). Depending upon the nature and seriousness of a given exposure, these manifestations may be quite severe or subtle. Subtle signs and symptoms, as noted previously, may represent early warning markers of more serious chemically related disease. The tabulation which follows provides some indication of the scope of xenobiotic activity as identified in the literature to date.

CARDIOVASCULAR

Hypertension
Irregular heart beat
Chest pain and tightness
Myocardial infarction

OPTHALMIC

Eye irritation
Dimness of sight (amblyopia)
Double vision (diplopia)
Blurred vision
Eye oscillation (nystagmus)
Abnormal pupil reactions

NEUROLOGICAL

These can be categorized into various subsets, as follows:

Nervous system arousal problems

- lethargy
- depression
- nervousness
- irritability
- emotional instability
- photophobia
- sleeplessness
- sleepiness

Associative

- decreased mental acuity
- impaired memory
- confusion
- disorientation
- slowed functional adolescent impairment

Physiological/Metabolic

- headaches
- emotional instability
- loss of appetite
- irritability
- fatigue

Sensory

- vision impairment
- hearing impairment
- perception changes (taste/smell)
- burning sensation
- paresthesias
- hallucinations

Motor

- speech impairment
- muscle weakness
- tremors
- difficulty walking
- seizures
- incoordination and clumsiness
- dizziness

Peripheral neuropathies

RESPIRATORY

Wheezing or difficulty in breathing
dryness of the nose and throat
chest tightness
nasal obstruction/congestion
coughing
chest pain (pleuritic)

DERMATOLOGICAL

Urticaria
acne
rash
darkening or thickening
discoloration or deformity of nails
dryness
sun sensitivity

GASTROINTESTINAL

nausea
vomiting
abdominal pain
abdominal cramps
diarrhea

MUSCULOSKELETAL

Joint pain
Swollen joints
myalgia

IMMUNE SYSTEM

Overactivity (allergies)

- Rhinitis
- Urticaria
- Alergic contact dermatitis
- Bronchial asthma
- Arthralgia (autoimmunity)

Underactivity

- Impaired host resistance

HEPATIC

jaundice
hepatomegaly

As one reviews these symptoms, it is possible to cross-categorize. For instance, the symptoms of fatigue and lethargy, in addition to being manifestations of neurological dysfunction, may be indications of a generalized metabolic dysfunction due to the possible deleterious effects of xenobiotics on intra-cellular tissue respiratory pathways (144,145). However, they may also be indications of having completed a hard day's work. Therefore, it is essential to note that persons exposed to toxic chemicals often complain of a constellation of symptoms (58,63); moreover, several studies have shown that the existing differences between exposed groups and control groups could not otherwise be explained without considering the etiologic role for exposure to toxic substances (53,93,98).

III. ASSESSMENT OF XENOBIOTIC EXPOSURE

The diagnosis of disease in an individual is generally based upon a clinical history and physical examination. The physician may then use additional information, including laboratory determinations (e.g., blood, urine and adipose tests) and more specialized procedures (e.g., radiological examinations and biopsies) in developing a possible diagnosis. Specific laboratory tests and exposure history questionnaires can be of value when they are critically interpreted. Exposure history questionnaires should be quite detailed in order to elicit complete information (including incidents a patient may not have recognized as exposure related) and should examine the work, home and general environments.

Correct interpretation of laboratory results requires knowledge of the accuracy and precision of the test, and the normal range of values found in healthy people.

In a review such as this it is not possible to adequately treat a topic as broad in scope as the diagnosis of chemically related ills. There are a great many tests available which could be used to assess organ and system functions. In arriving at a diagnosis, one would select, of course, those which are most appropriate based upon the observations and information to hand, including the known or suspected chemical agent to which an individual has been exposed. While the literature on this matter is voluminous, a good summary has been compiled by a scientific panel organized by the Board of Directors of Universities Associated for Research and Education in Pathology (146).

The following is an overview of tests which may be used to assess organ and system functions as they relate to chemical toxicity.

1. Liver function (147,148)

   (i) aspartate aminotransferase AST (SGOT)

   (ii) Alanine aminotransferase ACT (SGPT)

   (iii) gamma-glutamyl transpepsidase (GGTP)

   (iv) alkaline phosphotase

   (v) bilirubin

   (vi) Serum bile acids

2. Renal function (149-152)

   (i) Urinary specific gravity

   (ii) pH

   (iii) proteinuria

   (iv) BUN and serum creatinine levels

   (v) glomerular filtration rate

   (vi) renal enzyme activities

3. Reproductive function (153-155)

   (i) Sperm assays

   Semen physiology can be assessed by evaluating: a) count (density), b) motility, c) morphology (cytology), and d) YYF test (representative of Y-chromosome nondisjunction during spermatogenesis) (156).

   Factors such as age, smoking and medication need to be taken into consideration when interpreting the results from such studies (157).

   (ii) Ovarian and uterine function assays

4. Immunologic function (158-160)

   (i) white blood cell count and differential

   (ii) B cell and T cell counts (lymphocytes)

   (iii) T-lymphocyte activation tests

   (iv) T4/T8 ratios (T cell differential counts)

   (v) Serum Immunoglobulin screen

   (vi) Serum complement levels.

5. Lung function (161)

   (i) FVC

   (ii) FEVI

   (iii) Residual volume/total lung capacity ratio

   (iv) Alveolar diffusion capacity

6. Opthalmic function (162)

   (i) visual acuity

   (ii) visual field determinations. These may be of value in assessing low grade xenobiotic toxicity.

7. Nervous System (163-185)

   (i) Electrophysiological techniques to measure:

   a) Sensory nerve conduction velocity
   b) motor nerve conduction velocity
   c) electromyographic examination (may be used to assess peripheral nerve dysfunction)
   d) sensory loss

   (ii) EEG - may be useful in assessing latent or abnormal electrical activity in the brain as a result of xenobiotic exposure.

(iii) a) I.Q. tests (e.g., Wechsler Adult Intelligence Scale) and other tests to assess memory.

b) Personality profile evaluation or psychometric testing (e.g., Minnesota Multiphasic Inventory)

c) Perceptual-motor skill assessments, if used correctly and with objectivity, give a baseline of nervous system integrity.

d) Other standardized neurobehavioral and psychological tests (memory, problem solving, etc.).

Tests of blood, urine, adipose tissue or other organ tissues can, of course, also be carried out to directly assess xenobiotic body burdens. The above organ and system function tests are best carried out in company with such direct assays. A great deal more work is needed in this area, however, as our analytical capabilities have been far outstripped by the rapid proliferation of new chemical compounds.

IV. DETOXIFICATION METHODOLOGY

While we still do not fully understand the bio-active mechanisms or the pharmacokinetics of many toxic substances, physicians have known for centuries that health problems can ensue as a result of body burden accumulations of xenobiotics and have looked for ways to safely and effectively reduce body burdens.

Ramazzini, in his landmark 1713 work, Diseases of Workers, notes that writers of works on poisons at that time "advise, in general, remedies that have the power of setting the spirits and blood mass in motion and of provoking sweat"(1), a recommendation which seems at once simplistic and yet profound in light of what is now known, nearly 275 years later, concerning the pharmacokinetics and metabolism of foreign compounds.

Any procedure to reduce body burdens of lipophilic toxins must satisfy three essential requirements:

1. Enhanced mobilization of the stored chemical from lipid reservoirs.

2. Adequate distribution of mobilized chemicals to the portals of excretion.

3. Enhanced routes of excretion. Routes of excretion include:

hepatic
gastrointestinal
renal
skin: via sweat and/or sebum

From these fundamentals, an effective regimen for reducing body burdens of xenobiotics would consist of the following elements:

1. Enhanced mobilization of xenobiotics from lipophilic sites.

To enhance the mobilization of lipophilic chemicals, one has to find ways of increasing lipid turnover. By increasing mobilization, one can then free the stored xenobiotic into the circulation (176).

Factors that increase lipid mobilization include:

A. Exercise.

Numerous studies have demonstrated that exercise can increase the mobilization of lipids, and that the rate of mobilization is dependent upon rate of blood flow through the adipose tissue (177-190).

The energy requirements of exercising muscle are met by the oxidation of both fat and carbohydrate. For example, by 40 minutes of continuous exercise, plasma lipid (free fatty acid, FFA) contributes approximately 37% and plasma glucose 27% to muscle oxidative metabolism as assessed by the uptake of oxygen by leg muscles (191).

B. Nicotinic Acid (Niacin)

This vitamin, in high doses, has profound antilipolytic effects and has been used in the treatment of hyperlipidoemias. Nicotinic acid, however, blocks the mobilization of FFA from adipose tissue to the blood for only a short time, approximately 30 to 90 minutes, depending upon dose. This effect is followed by a pronounced rebound and overshoot of FFA in the blood (192-199).

C. Polyunsaturated oils

Several studies have shown that polyunsaturated fat feeding can bring about significant changes in body fat composition. Polyunsaturated oils have been found to replace existing adipose tissue stores, thereby mobilizing some lipids, as in a lipid exchange mechanism (200-203).

Mobilization of persistent fat-stored xenobiotics into the blood now permits their excretion through the various excretory pathways. If one only mobilizes these chemicals without enhancing their excretion there would be distribution of them to other tissue sites, such as the muscle compartment, with consequent redistribution back to the lipid areas.

It is theoretically unwise therefore to increase the mobilization of xenobiotics without ensuring their enhanced excretion. However, when utilizing the methodology described herein, analysis of blood concentrations of contaminants during treatment has shown that excretion keeps pace with the levels of xenobiotics mobilized from fat stores (204).

2. Increasing Circulation

Improving blood flow and cardiovascular efficiency will permit two things:

A. Increased blood flow through the adipose tissue, thereby enhancing the "pickup" of mobilized xenobiotics;

B. Increasing blood flow to the skin thereby enhancing xenobiotic elimination through sweat and sebum.

Three factors which would play a role in this are:

* the use of aerobic exercise, which enhances cardiac output and peripheral blood flow to adipose tissue and the epidermis;

* the use of heat stress, which increases circulation (205,206).

* the use of nicotinic acid which is a potent vasodilator (207, 208). Its effect seems to be largely dependent upon increased release of prostaglandins E2, a potent vasodilator, from the vascular wall. Its impact upon peripheral blood flow is at its greatest as the levels of nicotinic acid are rising in the blood (209).

3. Enhancing Routes of Excretion

A. Hepatic Function

The liver contains enzyme systems that biochemically transform lipophilic xenobiotic compounds into more water soluble derivatives. These polar derivatives can then be excreted by the kidneys (210-214), or into the bile (the production of which is enhanced by polyunsaturated oils, 215-217), and from there to the gastrointestinal tract and feces. This mixed-function oxidase (MFO) system is inducible, i.e., its activity levels can be increased. Factors that induce the hepatic MFO system are:

* elevations in the concentration of certain environmental chemicals such as DDT and other halogenated hydrocarbon insecticides, PCB's, urea herbicides, polycyclic hydrocarbons, the dioxins and chlorinated aromatic hydrocarbons (218).

* drugs (not used in the methodology described herein), such as phenobarbital (219),

It is evident therefore that increased lipid mobilization of xenobiotics will increase the xenobiotic load to the liver and thereby induce MFO system activation and this will enhance excretion.

B. Overcoming enterohepatic recirculation.

Various means have been suggested to overcome enterohepatic recirculation. Cholestyramine, high fiber diets, vegetable diets, sucrose polyester and paraffin have all been used (220-224). Each has a side effect which tends to stress the liver due to fat deposition. A less stressing approach to overcoming enterohepatic circulation is the use of dietary polyunsaturated oil. Total fecal steroid excretion has been increased by 45 percent through use of corn oil versus cocoa butter as the source of dietary fats (201). This type of supplement has been found to produce a decrease in plasma cholesterol which appears to be indicative of increased fecal excretion (214, 225).

Associated with overcoming enterohepatic recirculation is the potential for a lowering of absorption of important nutrients and thus increasing the toxicity of persistent chemicals such as PCB's and PBB's (226). This can be especially important for the lipophilic vitamins. Vitamin A, for example, undergoes extensive enterohepatic recirculation and must be supplemented at higher than normal doses if increased fecal excretion is likely (215). This is particularly important for PCB poisonings where animal studies show a significant decrease of vitamin A in the liver and serum during PCB administration thus leading to an increased A requirement (227,228).

Another essential vitamin supplement is ascorbic acid. It has been found, for example, that PCB contamination brings about a depression in the activities of the enzymes L-gluconolactone oxidase and dehydroascorbatase along with an increased urinary excretion of L-ascorbic acid. PCB toxicity disturbs the normal histological pattern of the liver cells and also significantly changes the hepatic lipid composition. L-ascorbic acid supplementation can afford protection against the enzyme activity alterations and histological changes resulting from PCB toxicity (229).

C. Renal excretion.

This depends on the efficiency of hepatic MFO system to conjugate and make more water soluble the derivatives from the nonpolar chemicals.

D. Epidermal excretion

This is a potential major pathway whereby toxic chemicals can be excreted, either via the sweat or sebum. Not only does increased heat exposure increase sweat production, but sebum also. Both sebum (230-239) and sweat (240-249) can act as routes of excretion for xenobiotics, including organohalides (233,250,251) and heavy metals (241-243,248). During epidermal excretion, of course, one must ensure adequate intake of water and appropriate salts as well as nutritional supplements to ensure the body does not become depleted.

V. CLINICAL SUMMARY

A. Safety.

The utilization of a methodology such as that outlined above has been accomplished safely and effectively and reports have appeared in the literature (250-254). The origin of the technique is somewhat unique in that it was developed by a non-physician, the late L. Ron Hubbard, who concluded in the early 1970's that residues of drugs and other contaminants stored in the adipose and set about developing a means of reducing body burdens. In the late 1970's the method began to be used by a number of drug rehabilitation facilities internationally.

While this demonstrated clearly the safety of the regimen, it was not until 1981 that physicians and environmental scientists began to look into the efficacy of the technique in addressing body burdens of some of the most persistent halogenated hydrocarbons. They found the method not only well grounded in the traditional literature, but surprisingly effective in reducing body burdens of toxicants previously thought to be more or less permanently stored in fat tissue. The results of these studies led to the utilization of the method by physicians in the U.S. and abroad, beginning in the early 1980's.

In California, my associates and I have treated approximately 1,300 individuals over the past 5 years. Referrals for treatment are predominantly from physicians and other professionals. A number of industries and insurers have been encouraged by the return to work following treatment of persons who had previously been on disability.

An initial study of the regimen on 103 individuals found it to be very well tolerated (252). Of course, such a program would be inadvisable for pregnant women, persons with coronary artery disease or certain other major physical disabilties.

With respect to the mobilization of xenobiotics from fat depots it has been suggested that such might result in elevated blood levels. However, as was noted previously, analysis of chemical concentrations in the blood during treatment indicates that excretion of body burdens keeps pace with mobilization from fat stores (251). In other words, there was no significant elevation of blood levels of toxicants during treatment.

B. Body Burden Reductions

Preliminary studies of this regimen have found it to bring about significant body burden reductions of several compounds examined, including the highly persistent PCB's and PBB's. A study by Schnare, et al, of Michigan farmers exposed to PBB examined 16 organohalides, including PCB and PBB congeners and three pesticides (250). 13 were present in lower concentrations at post-treatment sampling. Seven of the 13 reductions were statistically significant; reductions ranged from 3.5 to 47.2 percent, with a mean reduction among the 16 chemicals of 21.3 percent (s.d. 17.1 percent).

A gathering of physicians, toxicologists and researchers from the Mt. Sinai School of Medicine, Wayne State University, Battelle Laboratories and several other institutions and governmental agencies examined these preliminary findings and made recommendations which included a four month follow-up adipose biopsy of those treated. This follow-up analysis was completed and showed a reduction in all 16 chemicals averaging 42.4 percent (s.d. 17.1 percent) and ranging from 10.1 to 65.9 percent. Ten of the 16 reductions were statistically

significant. Thus, a continuing reduction of body burdens following treatment was clearly demonstrated.

In 1983, Roehm made a similar observation during treatment of a Vietnam veteran with a history of exposure to dioxin and DDE, a persistent metabolite of the now-banned pesticide, DDT (254). Adipose levels of DDE were determined using mass spectrometry pre-treatment and at four intervals post treatment. After 250 days DDE was determined to be 97% removed.

A more recent study examined PCB and HCB (hexachlorobenzene) congeners in electrical workers paired by age, sex and PCB exposure potential and divided into treatment and control groups (251). Both groups maintained their normal work routines during the treatment and follow-up periods. Adjusted for reexposure as represented in the control group, HCB body burdens were reduced by 30% at post-treatment and 28% at three months post-treatment. Mean reduction of PCB cogeners was 16% at post-treatment and 14% at three months post-treatment. Analysis of variance indicates these reductions are statistically significant ($F < .001$).

A great many individual case histories have demonstrated the efficacy of this method in reducing body burdens of certain organohalides. A capacitor factory worker, for example, with an extremely high PCB adipose tissue level of 102 ppm was recently treated. Post-treatment level was 37 ppm, a 65% reduction (255).

C. Symptom remission.

The achievement of body burden reductions might be of less importance if reversible symptoms were not relieved concurrently. Clinical observations noted in the literature and by physicians who have applied this methodology, however, suggest it brings about a significant improvement in signs and symptomatology. One study examined 120 individuals referred for treatment of health effects which diagnostic assessment suggested were due to chemical exposure (253). This patient population was selected to replicate the age and sex distribution of the population examined by Anderson, et al (64). Symptoms examined were based upon 15 health effects studied by Anderson in a PBB-exposed population and an unexposed control population from rural Wisconsin. The symptom prevalence in the pre-treatment group was comparable to Anderson's chemically exposed population, while symptom prevalence in the post-treatment group was significantly reduced and comparable to that identified in Anderson's unexposed control group (Figure 3).

A similar study was recently completed on 21 patients with known heavy exposures to contaminants such as pesticides, fungicides,

FIGURE 3

Symptom Prevalence of Chemically Exposed and Unexposed Reference Populations and a Chemically Exposed Treatment Group

Symptom	Chemically Exposed Population (Anderson)	Healthy Population (Anderson)	Treatment Group (pre-treatment)	Treatment Group (post-treat.)	[1]
Rash	17%	9%	18%	4%	**
Acne	12	5	16	4	*
Skin Thickening	9	3	9	4	
Paresthesias	19	5	14	2	**
Weakness	13	3	16	4	*
Uncoordination	21	5	7	0	*
Dizziness	20	3	18	2	**
Fatigue	52	15	79	5	**
Nervousness	22	2	14	4	*
Disorientation	6	0	11	0	**
Headaches	41	14	40	9	**
Joint Pain	43	23	5	0	*
Muscle Pain	23	8	42	5	**
Abdominal Pain	13	7	33	11	**
Constipation	6	2	26	2	**

1. The difference in symptom prevalence after treatment is significant at the following levels: * = $p < 0.05$; ** = $p < 0.01$.

solvents and PCB's. Statistical analyses were performed to determine the effects of this treatment on symptom severity. The analyses found a highly significant decrease in severity following treatment.

It is noteworthy that many of those who had been treated for severe chemical exposure had been in a diseased state for several months or years prior to treatment and had been examined and treated by several physicians, with little to no relief of signs and symptoms.

A 54 year-old woman, for example, was treated for heavy exposure to pesticides (256). Exposure had taken place approximately 5 years prior to treatment. In 1980, a neurologist determined her health problems to be chemically caused. Over the next 5 years she sought out a variety of physicians with no significant change in her health status. In 1986 adipose tissue levels of DDE were measured at 38 ppm with DDT at 4.8 ppm. Adipose heptachlor epoxide was measured at 33 ppm. Total PCB's were at 20 ppm. Following treatment, adipose DDE dropped to 3.5 ppm, DDT to .6 ppm, heptachlor expoxide to 1.2 ppm and total PCB's to 2.0 ppm. Alleviation of signs and symptoms was dramatic. Physicians have reported numerous similar case histories.

It should be noted that the initial study of this method (252) found that patients with high blood pressure had a mean reduction of 30.8 mm systolic, 23.3 mm diastolic. Cholesterol level mean reduction was 19.5 mg/100 ml, while triglicerides did not change. These findings of blood pressure and cholesterol level reduction have been confirmed over the past 4 years in the treatment of over 1,300 patients.

D. Significant decrease in drug, alcohol and tobacco consumption.

With regard to both discontinuance of substance abuse and body burden reductions, this detoxification methodology has been shown to be of considerable value. Body burden reduction data is limited due to limited analytical capabilities for adipose tissue. However, an adipose reduction in four subjects of approximately 50 percent of both THC and its hydroxy-metabolite was seen following 21 days of treatment (257). In one other case, PCP was identified in the urine of a police narcotics officer undergoing treatment 3 years after a bottle of concentrated liquid PCP was thrown into his face (258).

In examining alcoholism, a recent study by Laposata and Lange is of interest (259). They note that acetaldehyde, the end product of oxidative ethanol metabolism, contributes to alcohol-induced disease in the liver, but cannot account for damage in organs such as the pancreas, heart, or brain, where oxidative metabolism is minimal or absent; nor can it account for the varied patterns of organ damage

found in chronic alcoholics. They observed that many human organs metabolize ethanol through a nonoxidative pathway to form fatty acid ethyl esters. Organs lacking oxidative alcohol metabolism yet frequently damaged by ethanol abuse had high fatty acid ethyl ester synthetic activities and showed substantial transient accumulations of fatty acid ethyl esters. The fact that there may be an ethanol metabolite which stores in human tissues is worthy of further investigation.

With regard to substance abuse, a statistical analysis was recently completed of 204 patients who had used drugs, alcohol and/or tobacco prior to this particular detoxification treatment (260). Patients rated their use of these substances before and after treatment on a scale of 1 to 5 (light to heavy). The mean and median age of the patients was 34. Statistical analysis showed that using this treatment methodology, probability of improvement for drugs was 98 percent, for alcohol, 91 percent and for tobacco, 68 percent.

Of the 109 patients who had used so-called "recreational" drugs, all but 6 discontinued drug use following treatment and these 6 reduced drug use. 30 of these patients had rated their drug use as heavy (5 on the scale) and all of these discontinued drug use following treatment. Of the 16 patients who rated their alcohol use as heavy, 13 discontinued alcohol consumption following treatment.

E. Future studies.

While this methodology certainly provides sound and safe treatment for chemical exposures, the data reported on to date suggest several avenues for further work. A more detailed study of a larger cohort should be undertaken. There are, additionally, several compounds (the dioxins, for example) for which body burden reductions have not as yet been adequately studied. There is also a considerable variation in the percentage of reduction noted for the various organohalide congeners which have been studied. This is not well understood.

Several studies have found that a continuing reduction in body burdens takes place after treatment is terminated. An understanding of this phenomenon will require more extensive research on mobilization and excretion pathways.

The fact that symptom remission has been seen to accompany reductions of body burdens is encouraging. As there is a known progression of disease associated with the bioaccumulation of xenobiotics, it is likely that achieving substantial reductions of

such body burdens may lessen the risk of future disease and improve, overall, the health status of the individual. Such a detoxification methodology as is described above thus may prove an important addition to those tools available to the physician in assisting patients to cope with those chronic health problems which often follow serious chemical exposures.

Yours truly,

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