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ALBERTA OCCUPATIONAL MEDICINE NEWSLETTER

EDITORIAL COMMENTS

Reproductive Hazards of the Workplace. Dr. Heather Bryant's article in this issue is the first in a series of three on this topic. In the September issue she will present the data pertaining to female workers. The December article will be concerned with workplace effects on male fertility. Her objective will be to provide some information on which the clinician can base some advice to patients exposed to the agents discussed.

Her 'overview' gives information which promises to revolutionise the health supervision of working environments.

The majority of Canadian women of reproductive age are in the workforce, and with the blessing of Human Rights legislation are often undertaking jobs previously confined to men. The occupational environment has therefore become the setting in which our future generations will develop from the time of conception or even before it.

An acceptable occupational environment for an adult worker is one thing; that for a developing fetus with higher susceptibility to damage, and with more than a lifetime in which delayed effects may emerge, is another.

This places a heavy burden of need for research on a Canadian occupational health information system which is very imperfect and poorly suited to research. The VDT scare has shown that it is not enough to show where a hazard does exist; we must also be able to detect where it does *not* exist, or at least does not exist above a very low level of hazard.

Hair Analysis. Drs. Chisholm and Barnes will review the evidence that hair analysis is of value in the assessment of toxic exposures. They conclude that it has come to stay and that it has a place in assessing exposures to some toxic chemicals over time. It is clear that it has advantages over single blood or urine analyses in assessing past exposure over months or years.

Questions about which we are unclear are: Has the technique been validated in terms of the relationship of the results to toxic exposures of known levels and duration? They may have been, in some animals for some elements. Have clear correlations been established with health effects? Are there ranges of normal which are generally accepted and which can be interpreted in a generalised way? Or are these arbitrarily laid down by certain laboratories operating in certain regional settings?

We can only apply the technique of hair analysis with confidence in a particular clinical or community problem, when these questions have been answered with respect to the specific chemical of interest. Very few seem to have been answered as yet.

John Markham

A SELECTION OF OCCUPATIONAL HEALTH ORGANISATIONS OR SOURCES OF INFORMATION IN ALBERTA

1. Workers' Health, Safety & Compensation
   (a) Medical Toxicological Information Program (MTIP)
   - product ingredients; health effects; laboratory testing; treatment methods.
   -Phone 427-6724

   (b) Chemical Hazards Information Program (CHIP)
   - trade name products; control methods.
   - Phone 427-2687

   (c) Occupational Health & Safety Library
   - Chief Librarian: Mr. W. Keith McLaughlin
   - Phone 427-3530

2. Alberta Section American Industrial Hygiene Association
   - Secretary: Mr. J.D. (Jim) McLean
   - Phone 233-3244

3. Alberta Occupational Health Society
   - Secretary: Ms. Janet Tate
     519D - 33rd Street NW
     Calgary, Alberta
     T2N 2W5
   - Phone 283-1082

4. Alberta Occupational Health Nurses Association
   - Secretary: Ms. Lynn McManus
   - Phone 284-8666

COMING EVENT — ALBERTA

"MEDICHEM" - 11th International Congress on Occupational Health in the Chemical Industry

DATE: September 26-29, 1983

PLACE: The Calgary Westin Hotel
4th Avenue and 3rd Street S.W.
Calgary, Alberta

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ANNOUNCEMENT

Dr. Jim Cheng, Director, Medical Services has resigned from his position with the Occupational Health and Safety Division to enter into private occupational medicine practice. He has been involved in many professional activities such as the Alberta Occupational Society as its past president and initiated many programs geared towards the physicians in this province. His practice will be located in 50 Brentwood Blvd., Sherwood Park, T8A 2H5. For appointment, please call 467-4140. He is also available for consultation in

program development, epidemiological investigation, etc.

We would like to wish Dr. Cheng every success in his new practice.

REPRODUCTIVE HAZARDS OF THE WORKPLACE PART 1 - OVERVIEW

*Heather Bryant, B.Sc., M.D., C.C.F.P.**

There is a growing consensus that the study of reproductive effects on men and women at work is to be a topic of pressing concern in the next decade. While unions and management discuss what measures are to be taken when the possibility of hazard exists[1], articles are appearing in a wide range of scientific publications addressing the substantive and ethical issues surrounding this subject of interest[2-5]. The concern of government and the women's movement was demonstrated when the Canadian Advisory Council on the Status of Women sponsored a recently published report entitled "Reproductive Hazards at Work"[6]. This first in a series of three articles will discuss some of the motivations and questions behind this awakening of interest; some of the difficulties encountered in researching in the field will be briefly examined. Later articles will summarize some of the available information on specific suspected hazards to women and men in the workplace.

A major demographic shift in the workforce has been cited as a primary impetus to research in this area. Certainly, more women are employed than in the recent past, resulting in more potential for exposure of pregnancies to a workplace environment. In Canada, for example, the number of employed women rose from 1.8 million in 1961, to over 4 million in 1979[7,8]. Over three-quarters of these working women were in the fertile age period, between 15 and 44 years of age. The impact of this is even sharper when one considers the number of children now born who were exposed in utero to occupational settings. In 1972-73, 41.5 percent of all women in the U.S. having a live birth had worked at some time during the pregnancy[3]. This translated in 1980 to nearly 60 percent of women delivering their first children having worked for at least six months of their pregnancies, while a quarter of those bearing subsequent children were also working outside the home antenatally[4]. Thus, with such a large proportion of the childbearing and unborn population being exposed to the workplace, it is only natural and desirable that information about the possible consequences or risks of this setting be sought.

Another voice behind this movement is that of the general public or small groups of workers; the intensity of the concern they have demonstrated is not to be underestimated. It has become increasingly common for reports to appear in the lay press in which groups of people publicize what they believe to be unusual "clusters" of abnormal events, and attempt to attribute these events to a common environmental exposure. The recent fears concerning a possible relationship of video display terminals (VDT's) to a wide range of poor reproductive outcomes had their origin in just this sort of phenomenon. Beginning with reports of poor pregnancy outcome in four female VDT operators in Toronto[9], with scattered "clusters" reported since, the press has publicized the existence of a real concern amongst workers with this equipment. In short, the public is aware that their reproductive capabilities may be threatened at work, and are publicizing their right to know as much as possible about any risks.

Clinicians, too, require new information to advise patients regarding occupational restrictions necessary, if any, during pregnancy[4]. As the number of employed pregnant patients increases, and the workplace environments to which they are exposed become more diverse, physicians are being forced to address these concerns on an ever-increasing basis. However, a broader knowledge basis is needed to allow clinicians to give concise, individualized advice to their patients; it has been wisely pointed out that "(v)ague statements that 'all chemicals are to be avoided' are of no use to anyone."[4]

What, then, is the knowledge base from which we are operating, and what problems need to be addressed by clinicians and researchers in the future? First, it may reassure the reader to know that some epidemiological studies do exist which examine specific toxins or potential toxins in the workplace. Some of these will be discussed in the future articles in this series. However, many of these studies are begun only after a group of employees states its suspicion that the reproductive health of the workers is, in fact, different from the norm. The excellent work linking dibromochloropropane (DBCP) exposure to infertility in males[10] had its origin in workers' concerns regarding the collective infertility of the employees, discovered through casual conversations among the men. However, it is clear that this method of "case-finding", i.e., waiting for worker groups to discern a problem before following up with organized research, leaves large gaps in the existent knowledge, and, of primary importance, is potentially dangerous to workers.

There is, in fact, much that could be done by clinicians, employers, and epidemiologists alike before launching hundreds of studies aimed at examining the relationship of a wide range of environmental variables to worker fertility. Epidemiologists need to establish the *overall* effect, if any, of employment on women's reproductive capabilities. Some studies exist which suggest that employment itself may either select for subfertile women or be associated with poorer outcome. However, in general, these studies are either seriously flawed methodologically, or based on data collected more than two decades ago; then, working during pregnancy was more atypical, and the women doing so would be expected to be a selected group. These baseline studies are needed so that future work takes into account what the expected fertility patterns of working women are; only in this way can deviations from the "expected" values be detected.

Clinicians and employers, for their part, need to share in the task of adequately recording to what their patients and workers are exposed. While as yet our knowledge of toxins may be limited, it would be assisted greatly by alert physicians recording workload, and chemical and physical exposures of their patients, with the goal of finding pertinent associations if they exist. Employers, for their part, could attempt to improve exposure records of their employees, which could facilitate future retrospective and prospective studies. While it is recognized that clinicians and employers are in general busy enough, without adding "research activities" to their duties, such simple recording would provide some important starting points to direct other researchers' future work as efficiently as possible. This may allow any associations to be found early, before problems become widespread enough that the workers themselves notice adverse effects.

* Dr. Bryant is a Ph.D. candidate in the Department of Community Health Sciences, The University of Calgary.

REFERENCES

1. CHOSN (Canadian Occupational Health and Safety News). Corpus. 1981;4(24):4.
2. Bayer R. Reproductive hazards in the workplace: Bearing the burden of fetal risk. Milbank Mem Fund Q. 1982;60(4): 633-56.
3. Messite J and Bond M. Reproductive toxicology and environmental exposure. In: Zenz C ed. Developments in Occupational Medicine. Chicago: Year Book Med Publishers 1980:59-130.
4. Pries CN. Reproductive effects of occupational exposures. Am Fam Phys 1981;24(2):161-5.
5. Sever LE. Reproductive hazards of the workplace. JOM 1981;23(10):685-689.
6. Chenier NH. Reproductive hazards at work: Men, women, and the fertility gamble. Canadian Advisory Council on the Status of Women. Ottawa, 1982.
7. Women's Bureau, Dept of Labour. Women in the labour force, facts and figures. Ottawa 1971.

8. Women's Bureau, Labour Canada. Women in the labour force, facts and figures, Part 1. Ottawa 1978.

9. Toronto Star. 1982 Apr 27.

10. Whorton D, Krauss RM, Marshall S, and Milby TH. Infertility in male pesticide workers. Lancet 1977;2:1259-1261.

HAIR ANALYSIS - IS IT HERE TO STAY?

David M. Chisholm, M.D. and Priscilla Barnes, M.B., B.S.
*Derived in part from a paper by Joseph Nearing, M.D.**

Health concerns, health tests, health fads, and self-help, mutual-help and medical care - steady exponential growth in an otherwise cyclical economy. This proliferation inevitably leads to public confusion and professional consternation - the latter trying to distinguish fact from fiction. It gets no easier with time. Experience helps. Client advice, assistance and aid - driving forces to be knowledgeable and accountable. Oh what technology has wrought!

The Growth of Hair Analysis

Testing and measuring - the public is enamoured; the health professionals are dependent. Definitive diagnosis is enhanced; new syndromes and conditions are discovered or invented, and from the diagnostic and therapeutic world well intentioned yet occasionally exploitive, extrapolations are made to the preventive field such as for periodic exams and multi and monophasic screening. Some tests are worthwhile, others not.** Sophisticated exercise (stress) testing based upon arbitrary criteria has been critically challenged,[1] with evidence that reason is beginning to prevail.

Differing perspectives, varying opinions. The analysis of human hair is no exception. From the relatively obscure world of analytical chemists, forensic pathologists, and environmental health scientists, it emerges. Its non-profit and its commercial uses are increasing rapidly - by scientists and store front cultists alike (especially in the United States). The public is intrigued if not a bit bewildered. Physicians are, by and large, sceptical, partly due to lack of information. But seldom has a critical and balanced article on this topic appeared in commonly read journals - a recent and worthwhile exception being by Laker in The Lancet.[2] Personalized risk analysis, health promotion claims (e.g. heart disease), and other projected uses are perhaps premature, as cautioned by the College of Physicians and Surgeons of Ontario last October:

> "On an experimental basis, the technique appears to hold a promise of providing insight into the longer term nutritional status of populations in the community, and the exposure of humans to environmental hazards."[3]

In spite of this precaution, and as heretical as this may sound - hair analysis does have its place in the scientific tool chest.

Use of Hair Analysis

Although some would liken it to palmistry, there is more substance to the test than meets the eye. For it is not so much the appearance of hair - of interest to dermatologists, cosmeticians and others *-but indeed its very substance* as a repository of elements that has kindled so much recent attention. Noteworthy elements are arsenic in forensic medicine, mercury in occupational and environmental pollution, and zinc in nutritional deficiency. Less interest has been shown in the organic constituents of hair.

Trace elements have been of primary interest - often at concentrations less than 0.01% by weight. Hair analysis therefore could be considered a form of biological monitoring (the quantitative measurement of a substance in a body tissue). Not all elements are incorporated into hair, but most of the essential and toxic ones are, and their levels provide a record of their deposition over a period of time. It is being argued that hair can be considered a comparable tissue to blood, which also has many compartments, a dynamic state, and transient repository characteristics. Hair analysis should be used as an adjunct to other biological measurements, ideally as a preliminary screen, and/or selectively hair can be used as an analytical substitute for other tissues.

As an analytical technique, it is a method or means, not an end unto itself. Therefore, in utilizing it in surveys or clinical investigation, three points should be considered:

- *Why, What and When to Test* - detection and measurement of trace elements and their relationship to health/disease (the underlying premise or hypothesis)
- *How To Test and Who Does The Test* - techniques to ensure accuracy, precision, reliability, quality and standardization (mainly laboratory capability)
- *Application of Test Results* - how results are relayed to investigators and interpreted by them and the subjects, the assurance of repeat follow-up tests if necessary, and the meaningful use of results.

In a young field, these three issues are rapidly being clarified. The use of sophisticated laboratory tests such as neutron activation analysis, flameless atomic absorption spectrophotometry, and electron microprobe analysis now allow for detection to the range of 0.1 part per million or even to several parts per billion. The International Atomic Energy Agency (Vienna) and the U.S. Environmental Protection Agency, and more recently the Hair Analysis Standardization Board, have been successfully establishing and gaining the voluntary acceptance of quality control standards.

Research and commercial laboratories generally test for one or more of the following elements† and classify them as to their clinical significance in hair.

Clinical Significance in Hair

Essential elements -
- Calcium
- Magnesium
- Zinc
- Copper
- Chromium

Toxic elements -
- Lead
- Mercury
- Cadmium
- Arsenic
- Nickel

Elements of Suggested Clinical Significance In Hair

- Sodium
- Potassium
- Selenium

Unknown Clinical Significance In Hair

- Aluminium
- Cobalt
- Iron
- Lithium
- Manganese
- Molybdenum
- Phosphorous
- Vanadium

Deposition in hair, especially the scalp, is both endogenous and exogenous (environment, shampoos). Elaborate laboratory washing techniques are used to decrease exogenous deposition although brisk scientific debate continues as to the best method. Preferably hair analysis is done in conjunction with a detailed nutritional analysis due to the obvious dietary relationship of results to body trace elements.

Highlights of the Relevant Art and Science

A thorough literature search and review was undertaken by Dr. Joseph Nearing in late 1982.*[4]

Positive Aspects of Hair Analysis

Specimen collection is quickly and easily performed and is non-invasive. Specimens do not deteriorate. Hair itself is inert and the matrix is chemically homogeneous; mineral elements are incorporated into hair during protein synthesis at the hair follicle level. Short term metabolic variations of trace element concentrations are averaged out and therefore analysis is a way of detecting long-term variations of the concentration of these substances. Some drugs have shown to accumulate in hair and it seems likely that with suitable

analytical techniques certain organic compounds might also be measurable. The analysis of hair provides a record of past and more recently incorporated elements. With special techniques the history of exposure can sometimes be deduced from the linear distribution of elements along the hair shaft.

Concerns Regarding Hair Analysis

A number of physiological and environmental factors influence the results and usefulness of hair analysis. Variables include age, sex, hair color, hair products and grooming aids, and the hormonal, nutritional and general health status of each individual. The subject's dietary intake and individual absorptive ability could influence values obtained. Hair from different parts of the body often has different concentrations of the elements. Another major concern is the normal value range. Ideally, according to Ryabukhin[5], the establishment of this range requires statistically random sampling over an entire area with subsequent analysis for homogeneity of the sample and identification of particular sub-groups. Comparison between researchers can be a problem due to differences in pre-analytical procedures for collecting and handling hair. Further problems in the establishment of a normal value range lies in the definition of normal groups, as well as statistical considerations; namely, the standard deviations for the majority of trace elements are approximately equal to or exceed the arithmetic means. Differences within one order between any means or medians for the various groups do not justify the assumption that a group with a higher value of the mean or median may not be regarded as normal. In spite of these possible shortcomings, evidence to date shows reasonably good consistency between researchers and analysts. As noted previously, worldwide standardization is gradually overcoming these problems.

The Future

Hair Analysis is beginning to be recognized as a reputable and potentially reliable scientific test for some substances. It is a good initial primary population screening tool with regard to measurement of body trace elements, but results need to be evaluated in conjunction with possible environmental pollutants, nutritional analysis, and other clinical biochemical tests. Continued research and careful use will further clarify the value of this test as part of the health scientist's and physician's armamentarium, particularly as applied to occupational health surveillance, environmental and public health studies, and as an adjunct to definitive diagnostic analysis. Individual participants, be they patients or research subjects, should receive adequate interpretation of the results as well as sound clinical follow-up where results so indicate.

* Dr. Chisholm is the Medical Director and Dr. Barnes the Coordinator of Clinical Services for Shell Canada Resources Ltd. Dr. Nearing is an Occupational Medicine Resident at the University of British Columbia who undertook a preceptorship at Shell in December 1982.

So how are things with our former hazards of the reproductive workplace?

** A thorough analysis and rational criteria were published in the Task Force Report on the Periodic Health Examination which received international attention if not universal acclaim.

† Classification scheme is used by MineraLab, Inc., Hayward California (1982).

*[4] Limited copies including a bibliography are available from the authors.

REFERENCES

1. Chisholm DM. Pre-exercise evaluation: Confusion and controversy heading for clarification. Canadian Journal of Public Health 1981;72(Jan-Feb):22-25.
2. Laker M. On determining trace element levels in man: The uses of blood and hair. Lancet 1982;31(Jul):260-61.
3. The College of Physicians and Surgeons of Ontario. Interim Report - College position on hair analysis. 1982 Oct.
4. Nearing J. Literature review of the technique of hair analysis. Calgary, Alberta: Occupational Health Centre, Shell Canada Resources Ltd. 1982(Dec)6.
5. Ryabukhin YS. International coordinated program on activation analysis of trace element pollutants in human hair. Brown and Crounse, eds. Hair, trace elements and human illness. Craeger 1980:3-33.

COMING EVENTS — ELSEWHERE

July 19-22, 1983:
Second International Conference on the Clinical Chemistry and Chemical Toxicology of Metals; Montreal, Canada.

August 28-September 2, 1983:
Symposium on Chlorinated Dioxins and Dibenzofurans in the Total Environment II; Washington, D.C.

November 9-11, 1983:
Canadian National Congress of Occupational Medicine; The Westin Hotel, Toronto. To be held in conjunction with the annual meetings of the Canadian Council and the Canadian Board of Occupational Medicine.

N.B. Further information concerning any of the above may be obtained from the editor,

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Contributions such as articles, letters or questions are welcome.