U.S. DEPARTMENT OF HEALTH AND HUMAN SERVICES ▪ Public Health Service
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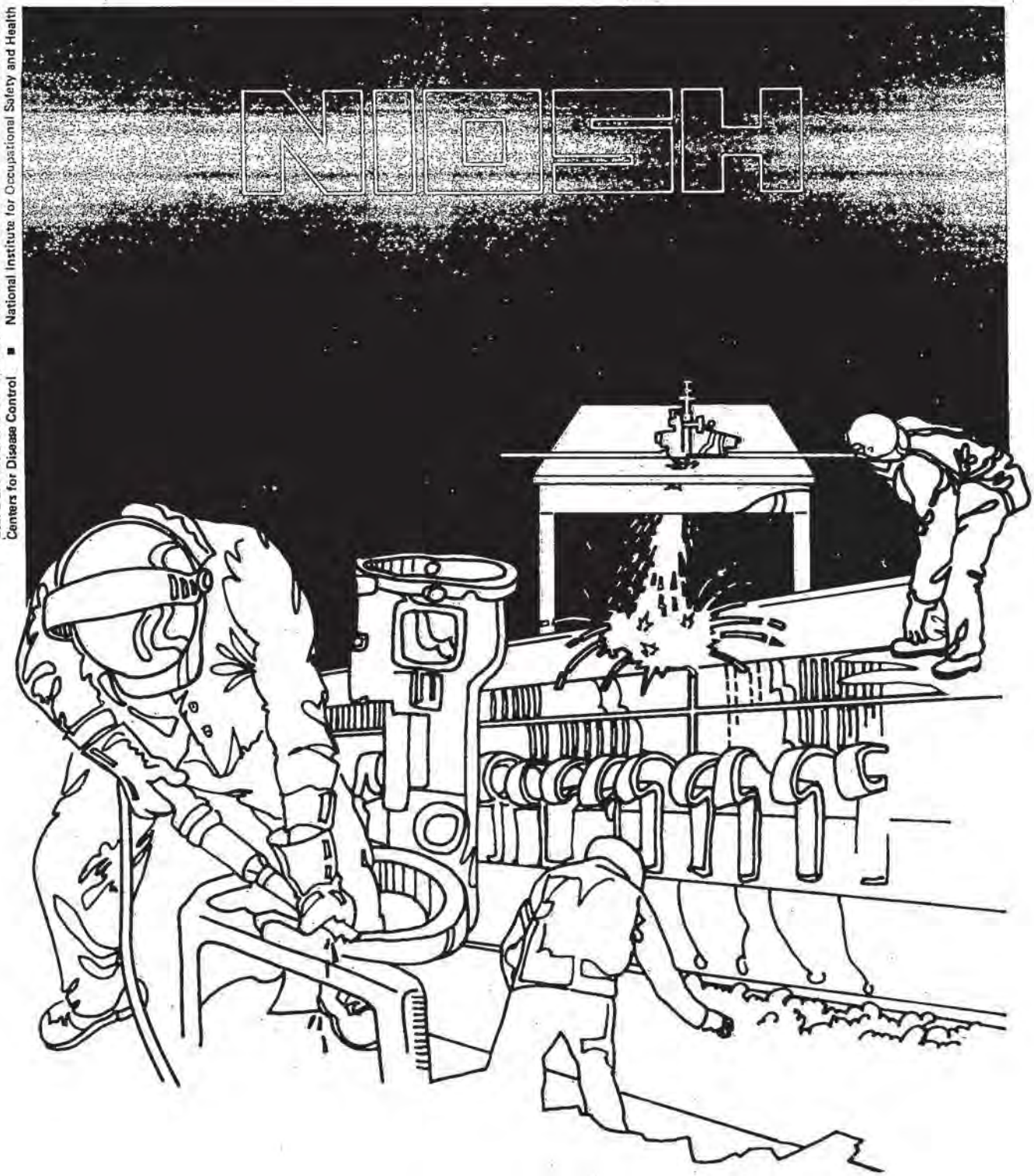

Health Hazard Evaluation Report

HETA 81-304-1361
ROBERTSON PAPER BOX COMPANY
MONTEVILLE, CONNECTICUT

PREFACE

The Hazard Evaluations and Technical Assistance Branch of NIOSH conducts field investigations of possible health hazards in the workplace. These investigations are conducted under the authority of Section 20(a)(6) of the Occupational Safety and Health Act of 1970, 29 U.S.C. 669(a)(6) which authorizes the Secretary of Health and Human Services, following a written request from any employer or authorized representative of employees, to determine whether any substance normally found in the place of employment has potentially toxic effects in such concentrations as used or found.

The Hazard Evaluations and Technical Assistance Branch also provides, upon request, medical, nursing, and industrial hygiene technical and consultative assistance (TA) to Federal, state, and local agencies; labor; industry and other groups or individuals to control occupational health hazards and to prevent related trauma and disease.

Mention of company names or products does not constitute endorsement by the National Institute for Occupational Safety and Health.

HETA 81-304-1361
AUGUST 1983
ROBERTSON PAPER BOX COMPANY
MONTEVILLE, CONNECTICUT

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I. SUMMARY

In May, 1981, the National Institute for Occupational Safety and Health (NIOSH) received a request for a Health Hazard Evaluation at Robertson Paper Box Company, Monteville, Connecticut. The request concerned a recent occurrence of a fatal case of aplastic anemia among the workers on the possible association between that case and exposure to dipropylene glycol monomethyl ether (DPGMME) in the U. V. wash solution in the color press area of the facility.

In the summer and fall of 1981, a medical team from the Occupational Health Program at Yale University (under contract to NIOSH) conducted medical examinations of eight exposed workers. These examinations included medical history and exposure questions, physical examinations, and a hematological evaluation which included bone marrow aspiration and biopsy. In October, 1981, a NIOSH industrial hygienist collected seven environmental air samples to evaluate exposures to dipropylene glycol monomethyl ether in the color press area of the plant. In addition bulk samples of the cleaning solution were collected for analysis.

The seven environmental air samples found airborne concentrations of DPGMME to range between 0.60 to 6.43 ppm. Those concentrations were all below the current OSHA standard of 100 ppm. The bulk samples of the wash solution contain 2-propanol, DPGMME, and a small amount of ethylene glycol monoethyl ether. No benzene was detected in any of the cleaning solutions being used in the plant.

The eight examined workers ranged in age from 23 to 59 years and the duration of exposure to the U. V. wash ranged from one to six years. Physical examination, blood counts, differentials, and platelet counts were all within the normal range. Bone marrow biopsies revealed a strong array of pathological findings including six with myeloid hypoplasia. Comparisons with bone biopsy specimens from melanoma patients (as a control group) was inconclusive due to the high prevalence of abnormalities in the melanoma group.

A high prevelance of clinically inapparent, bone marrow injury was found in this group of employees at the Robertson Paper Box Company. Although the etiology of these charges could not be precisely determined, exposure to dipropylene glycol monomethyl ether and/or ethylene glycol monethyl ether are suspected as the cause of these health effects. Recommendations to reduce exposure to these substances are found in Section VIII of this report.

KEYWORDS: SIC 2752, dipropylene glycol monomethyl ether, ethylene glycol monomethyl ether, glycol ether, bone marrow injury, aplastic anemia.

II. INTRODUCTION

In May 1981, NIOSH received a request for a health hazard evaluation at Robertson Paper Box Company, Monteville, Connecticut. The request concerned the occurrence of a fatal case of aplastic anemia among the workers at that facility and the possible association between that case and exposure to dipropylene glycol monomethyl ether.

The NIOSH evaluation includes a walk through survey and medical examination of eight exposed workers by a team from the Occupational Health Program at Yale University (under contract to NIOSH) in the summer and fall of 1981. In addition, in October 1981, a NIOSH industrial hygienist conducted an industrial hygiene survey at the facility. Results of these evaluations were presented to the company and to the employees in May 1982.

III. BACKGROUND

Robertson Paper Box Company, Inc., is a commercial offset printing facility in Monteville, Connecticut, employing approximately 500 men and women. Employees are represented by United Steel Workers of America, Local 14977.

The NIOSH evaluation focused on the color press areas where the worker with aplastic anemia had worked. These presses are operated for a full 2 shifts 5 days per week. Three people work each press per shift - pressman A, pressman B, and the pressman's helper. At each press the helper spends more time at the feeding end of the press than either pressman. An ultraviolet cure process is used from 20 to 50% of the time on the five-color press only; the remainder of the runs on the five-color press, and all runs on the six-color press are oil based. Oil based runs present similar exposures and conditions on both presses. Local ventilation is by canopy hood at the finish end of each press; there is no local exhaust between the rollers.

Opportunity for respiratory and dermal contact with inks, diluents and blanket washes occurs primarily during end of job and end of shift washing of presses, blankets and plates. Additionally, rollers are often wiped down during the run. Both wipe down and washing operations require going in the unventilated area between rollers and using either wash-soaked rags or spraying the rollers with wash solution and wiping off with dry rags. Gloves are only intermittently used by some workers. Other opportunities for exposure occur because containers of diluent and wash solutions are left open on the benches during the run and during refilling of containers and squirt bottles. This latter task is the responsibility of the helper.

The company has had all seven employees with substantial contact with the U.V. process on the five-color press examined by a physician and tested for blood chemistries, complete blood count and differential and urinalysis. Results of all examinations were within normal limits for the laboratory.

In November 1980, Federal OSHA performed a detailed environmental survey of the five and six-color press area. As noted above detergents had already been substituted for glycolated ethers in the U.V. wash process. Bulk measurable quantities of the following were found:

1 hexanol	Methyl ethyl ketone
2 terpinol	ethyl benzene
coal tar naphtha	glycerol triacetate
xylene	stoddard solvent
toluene	acrylic epoxy resins
dichloromethane	pigments and non-volatile diluents
1,2 dichlorethylene	
1,1,1 trichlorethane	

In addition, bulk sampling of the formerly used U.V. wash solution confirmed its constituents as dipropylene glycol monomethyl ether and 2-propranol. There were no measurable amounts of benzene, ethylene glycol ethers or any other substance highly suspected of human bone marrow toxicity.

Quanitative air sampling by OSHA included whole shift personal and area collections. Results demonstrated that all substances (excluding dipropylene glycol monomethyl ether) were present in concentrations below established OSHA standards or ACGIH TLV's.

Based on the initial evaluation of the process, the company decided to switch to a substitute material for the U.V. wash.

However, in the early part of 1981, based on the observations of workers and management regarding the limited efficacy of the substitute detergent in the U.V. clean-up process, U.V. wash containing dipropylene glycol monomethyl ether was reintroduced at the five color press. Work practices were changed to limit possible dermal exposure to the solution but frequent intermittent airborne contact resumed. Additionally, the proportion of time spent at the five color-press on U.V. jobs had increased from about 20% to about 50% of the total work week. Because of continued concern by all parties, a request for a NIOSH Health Hazard Evaluation was submitted.

IV. METHODS

A. Environmental

On October 7, 1981, air samples (three personal breathing zone and four area) were taken during the end of the second shift cleaning operations of a UV cured job on the five color press.

MSA model G pumps at flow rates of 1 to 1.5 lpm were used for the personal samples and one area sample, and Sipin pumps at flow rates ranging from 0.14 lpm to 0.25 lpm for remaining area samples. Samples were collected on jumbo charcoal tubes and analyzed by gas chromatography with flame ionization detectors for dipropylene glycol monomethyl ether at the Utah Biomedical Testing Laboratory. Whatman filter paper was used to take wipe samples.

Bulk samples of the two washing solution were also collected and analyzed by GC/MS with particular attention to the presence of benzene.

B. Medical

Because of the limited number of men exposed and because of the insensitivity of usual clinical tools (i.e., complete blood count, physical examination etc.) as indicators of early marrow involvement, the investigators opted to direct clinical efforts at the target organ of exposed subjects - bone marrow. All seven men currently working on the five-color press and one recent retiree were invited to participate. Subsequently, two other men, a foreman and the ink mixer were invited because of suspected exposure. All examinations were performed with informed consent at Yale-New Haven Hospital at the Occupational Health Clinics. Approval of the Yale University School of Medicine Human Investigation Committee was obtained in advance.

The protocol consisted of four components:

1. Health and environmental exposure questionnaire completed during an interview with a staff physician.

2. Physical examination focusing on the reticuloendothelial organs.

3. Peripheral blood examination for complete blood count, differential, platelet count and reticulocyte stain; serum and red cell folate; B12 level.

4. Bone marrow aspiration and biopsy obtained under local anesthesia from the posterior superior iliac crest with a Jamshidi needle by a hemotologist. Marrow was examined with the following preparations:

   a. Wright and hematoxylin and eosin stains of aspirate and biopsy for morphologic and quantitative analysis.

   b. Aspirate was cultured for cytogenetic analysis.

   c. Special stains with DNA esterase, PAS and Sudan B by standard methods.

All subjects received complete results of their examination within one month of their visit. In addition to this communication, the principal investigator visited each subject at the plant to discuss these results, personally and privately.

C. Controls and Statistical Methods

Because of the discomfort of the procedure, control bone marrow biopsies were sought from the pathology files of Yale-New Haven Hospitals. A group of bone marrow biopsies obtained on a protocol from patients with malignant melanoma but without known hematologic abnormalties or marrow involvement were chosen. These ten subjects ranged in age from 38 to 63 with a mean of 52 years. Although hardly 'matched' or 'normal', they were selected as an available and definable group marrowed prior to treatment without knowledge of the presence of hematologic disease.

Study and control marrows were relabeled and mixed for reading by a hemotolic pathologist who was unaware of the clinical status of the patients. Marrows were rated for the following characteristics:

1. total cellularity (low, normal/high)

2. presence of PAS-positive stromal material (present, absent)

3. myeloid/erythroid ratio (normal, relative myeloid hypoplasia)

4. presence and distribution of iron (low, normal, high)

5. presence of infiltrate of lymphocytes, plasma cells, mast cells or macrophages (present or absent)

Two by two contingency tables of cases and controls were examined for the major parameters of marrow injury - hypocellularity, relative myeloid hypoplasia, and the presence of PAS positive stroma. Chi-square tests were performed for significance; remaining features were inspected for trend.

V. EVALUATION CRITERIA

A. Environmental Criteria

As a guide to the evaluation of the hazards posed by workplace exposures, NIOSH field staff employ environmental evaluation criteria for assessment of a number of chemical and physical agents. These criteria are intended to suggest levels of exposure to which most workers may be exposed up to 10 hours per day, 40 hours per week for a working lifetime without experiencing adverse health effects. It is, however, important

to note that not all workers will be protected from adverse health effects if their exposures are maintained below these levels. A small percentage may experience adverse health effects because of individual susceptibility, a pre-existing medical condition, and/or a hypersensitivity (allergy).

In addition, some hazardous substances may act in combination with other workplace exposures, the general environment, or with medications or personal habits of the worker to produce health effects even if the occupational exposures are controlled at the level set by the evaluation criterion. These combined effects are often not considered in the evaluation criteria. Also, some substances are absorbed by direct contact with the skin and mucous membranes, and thus potentially increase the overall exposure. Finally, evaluation criteria may change over the years as new information on the toxic effects of an agent become available.

The primary sources of environmental evaluation criteria for the workplace are: 1) NIOSH Criteria Documents and recommendations, 2) the American Conference of Governmental Industrial Hygienists' (ACGIH) Threshold Limit Values (TLV's), and 3) the U.S. Department of Labor (OSHA) occupational health standards. Often, the NIOSH recommendations and ACGIH TLV's are lower than the corresponding OSHA standards. Both NIOSH recommendations and ACGIH TLV's usually are based on more recent information than are the OSHA standards. The OSHA standards also may be required to take into account the feasibility of controlling exposures in various industries where the agents are used; the NIOSH-recommended standards, by contrast, are based primarily on concerns relating to the prevention of occupational disease. In evaluating the exposure levels and the recommendations for reducing these levels found in this report, it should be noted that industry is legally required to meet only those levels specified by an OSHA standard.

A time-weighted average (TWA) exposure refers to the average airborne concentration of a substance during a normal 8- to 10-hour workday. Some substances have recommended short-term exposure limits or ceiling values which are intended to supplement the TWA where there are recognized toxic effects from high short-term exposures.

B. Toxicity

Dipropylene Glycol Monomethyl Ether (DPGMME)

Dipropylene glycol monomethyl ether is a colorless liquid of low volatility. It has low single dose toxicity in animal testing. Exposure may be transiently painful to the eyes, but does not appear to cause significant eye damage.[1]

There is currently no available data relating exposure to this agent to bone marrow toxicity. However, a related chemical ethylene glycol monomethyl ether has been associated with suspected marrow damage in animals and humans.[2,3,4,5] The current OSHA standard for DPGMME is 100 ppm or 600 mg/m^3.

VI. RESULTS

A. Environmental

Bulk sampling of the solutions used during clean-up of the 5-color press was comparable to that of OSHA, except for the presence of a small peak for ethylene glycol monoethyl ether, not previously found. Consultation with suppliers revealed that this is present at a concentration of 10% in the blanket wash solution used on all presses. No benzene was detected in either bulk sample.

Air sampling results for dipropylene glycol monomethyl ether were as follows:

RESULTS

Sample Type	Location/employee	Duration	Vol.(L)	mg/M3	ppm
Personal	A Pressman	38 min.	54.7	10.7	1.78
Area	Work Bench	38 min.	33.3	39.0	6.43
Personal	Helper	40 min.	50.0	22.0	3.63
Personal	B Pressman	40 min.	53.5	33.6	5.54
Area	Between Presses	32 min.	08.1	32.9	5.43
Area	Top of Press	39 min.	09.2	26.9	4.45
Area	Ink Storage	38 min.	05.5	03.6	0.60

Three wipes samples were also analyzed and the results were as follows:

1) Glove.....greater than 0.01mg/sample
2) Hand (after removal of glove).....less than 0.01 mg/sample
3) Workbench.....greater than 0.01 mg/sample

B. Medical

1. Case History of Initial Case

The worker, a 39 year old white male, was in good health prior to July 1980, when fatigue, weakness, and dyspnea developed. He was admitted to a local hospital on August 7th with complete blood count revealing profound pancytopenia. A prior CBC in January 1980, had been normal. There was no past history of hematologic disease.

Environmental history revealed that the subject drank approximately 72 oz. of beer daily, was a light smoker and took no medications. He had worked at Robertson for 19 years; for the last five years he had worked full-time as an offset printer in the five and six-color press areas. About 20% of his time over the six months prior to the onset of his illness had been spent at the five-color press using an ultra-violet developing acrylic process; 30% was spent at the five-color press doing non ultra-violet jobs and 50% was spent on the six-color press (non ultra-violet). He had no avocations or hobbies requiring use of volatile substances nor known exposure to pesticide.

After initial stabilization, the patient was transferred to Yale-New Haven Hospital.

On admission to this hospital the physical examination was remarkable only for a mild sinus tachycardia and the presence of petechiae on his lower extremities. There was no splenomegaly.

Laboratory examination revealed a hemoglobin of 10.4 gm and a hematocrit of 30.4%. The patient had been transfused at the other hospital. The white cell count was 2,200 and the platelet count was 15,250. A 200 cell differential revealed 44% segmented neutrophils, 6% bands, 30% lymphocytes, 2% monocytes, 8% atypical lymphocytes, 4% metamyelocytes, and 6% blast forms. Coagulation studies, renal function tests and electrolytes were all within normal limits. A bone marrow examination revealed a markedly hypoplastic inaspirable marrow. The cellularity was less than 10% but there was no increase in collagenous fibers. Findings consistent with a stromal injury pattern included markedly increased iron, increased megakaryocytes and the presence of many immature megakaryocytic precursors. At that time no blast clusters were seen and there was no evidence for a hematopoietic neoplasm. A liver-spleen scan was entirely within normal limits. The VDRL was negative, antinuclear antibody was negative at 1/8 dilution, heterophile antibody was negative, and viral and microplasma titers were all within normal limits. The quantitative hemohlobin electrophoresis revealed Hb AA as the predominant species with 1.9% A_2 and 0.8% Hb F. The vitamin B_{12} level was 410 picograms/ml and the red cell folate was 126 nanograms/ml. The leukocyte alkaline phosphatase was 86 units and the Hamm's test was negative.

One month following discharge the patient remained pancytopenic and dependent on platelet and red cell transfusions. A repeat marrow examination was performed. This again showed a striking injury pattern with panhypoplasia but no evidence of hematopietic malignancy or myelofibrosis.

Over the course of the next month the patient did relatively well on transfusion therapy. The liver became palpable 4 cm below the right costal margin and a spleen tip was easily felt 3 cm below the left costal margin.

In view of the persistence of small numbers of circulating blast cells and the absence of a response to three months of exymethalone therapy, the patient was readmitted to the hospital for induction chemotherapy for presumed aleukemic leukemia. However, his condition quickly deteriorated, and he expired a few days later.

Postmortem examination revealed massive intra-alveolar pulmonary hemorrhage with hemorrhage also present in the heart, renal pelvis, bladder, urteters, GI mucosa, brain, gallbladder, liver and spleen. Extensive postmortem examination of the bone marrow was yielded to be strikingly depleted to cellular elements. Fibrosis was noted. The small foci of remaining marrow did not demonstrate the presence of any leukemia.

2. Medical Study

a. Study Subjects

Five of seven active pressmen and helpers, the foreman and the ink mixer elected to participate, two active workers and the recent retiree declined. Each participating subject completed the entire protocol. All were white males, ranging in age from 23 to 59. Duration of employment in printing ranged from 3 to 26 years; duration of exposure to U.V. wash ranged from one to six years. Although no quantitive measures of individual dermal and respiratory exposures were available, it was agreed that average exposure of pressmen and helpers exceeded that of the mixer; each exceeded the less direct contact of the foreman who was stationed 20 feet from the press and had minimal dermal contact.

None of the subjects had had a known blood dyscrasia or family history of same; none was recently exposed to medications or other toxins known to cause marrow injury. One subject had diabetes mellitus, controlled with insulin; another was taking propranalol and digoxin for cardiac arrythmia. Only one had taken any medication within the year associated with marrow toxicity (indomethacin, 150 mg daily x seven days -- ten months prior to the study); two men claimed occasional use of solvents at home in woodworking or carpentry; another three had had indirect contact with organochlorine pesticide used around their homes. In no case was exposure intense or prolonged.

b. Health Survey

Physical examination failed to reveal pathologic lymph nodes in any subject; none had an enlarged liver or palpable spleen. Further, examination failed to reveal evidence of any systemic disease associated with hematologic abnormalities.

Complete blood counts, including smears, differential and platelet counts were normal in all seven men. Each had normal blood levels of folate and vitamin B12. These data are presented in Table II.

c. Bone Marrow Examinations

Aspirates of bone marrow failed to reveal significant abnormalities on any of the study subjects on the usual or special stains. Cytogenetic evaluation of cultured cells revealed a normal 46 x,y pattern in all.

Biopsies of the seven cases revealed a striking array of pathological findings summarized in Table III. In three of seven, PAS positive stromal tissue indicative of injury was present; all three had absolute myeloid hypoplasia. In three additional marrows myeloid hypoplasia was present without identified stromal injury. Other findings included non-specific increases in iron deposition (significant in two) and cellular infiltrates (significantly abnormal in two).

Unfortunately 'control' marrows also proved highly abnormal (Table IV). Most strikingly, five of the controls were frankly iron deficient, suggesting some source of bleeding or nutritional deficiency; four of these subjects had stromal injury changes and myeloid hyperplasia. Among the remaining six, two had stromal injury and myeloid hypoplasia and two others had relative myeloid hypoplasia despite increased cellularity overall. The remaining two had only nonspecific findings.

Because of the high prevalance of abnormalities in the melanoma group, the findings in the study population were significantly different only in respect to iron stores. Even with the iron deficient controls removed there was no statistically significant difference between the groups.

VII. DISCUSSION

Despite the absence of clinical disease or abnormal circulating blood cells, bone marrow biopsies on co-workers of the index case suggest sub-clinical toxicity. We have attempted to confirm that these

findings differ from incidental abnormalities using an available set of 'control' marrows; unfortunately the high prevalence of injury, probably related to the subjects underlying malignant melanoma and its systemic consequences, vitiated this attempt. Yale Occupational Medical Program is presently assembling a second set of controls taken at autopsy from young victims of motor vehicle accidents or sudden cardiovascular death to better define the prevalence of marrow injury changes in the 'normal' population.

Despite this problem, it seems unlikely that the findings in the study group are, in fact, incidental. Assuming a true difference from normal, these data tend to inplicate a common marrow toxin; no underlying disease state is available to explain the findings in the group.

Given this assumption, it is our present hypothesis that glycol ethers are the suspect causal agent. Dipropylene glycol monomethyl ether is of concern because of the documented exposures to a high-concentration solution ("U V wash") and the absence of reliable animal data. Ethylene glycol monoethyl ether, undetected initially but identified in a 10% solution in blanket wash is a potential confounder. This agent is suspected to be capable of marrow toxicity in recent animal studies(5).

VIII. RECOMMENDATIONS

1. Ethylene glycol monomethyl ether and dipropylene glycol monomethyl ether should be used with caution in the cleaning process. If possible, a substitute material (containing ingredients with less toxicity) should be used. In the absence of a suitable substitute, employee exposure to these substances should be monitored and steps taken to minimize exposure.

2. Employee technique in cleaning the rolls seems to be a major factor in the amount of exposure, both via inhalation and skin absorption. Care should be taken to avoid unnecessary spills and splashes while cleaning the rolls.

3. Disposable coveralls, impervious to DPGMME, should be provided to employees performing the clean-up operation on both types of presses. This will minimize employee exposure through skin contact.

IX. REFERENCES

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IX. AUTHORSHIP AND ACKNOWLEDGEMENTS

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X. DISTRIBUTION AND AVAILABILITY OF REPORT

Copies of this report are currently available upon request from NIOSH, Division of Standards Development and Technology Transfer, 4676 Columbia Parkway, Cincinnati, Ohio 45226. After 90 days, the report will be available through the National Technical Information Service (NTIS),

5285 Port Royal, Springfield, Virginia 22161. Information regarding its availability through NTIS can be obtained from NIOSH Publications Office at the Cincinnati address. Copies of this report have been sent to:

1. Robertson Paper Box Company
2. (Requestor)
3. NIOSH, Region I
4. OSHA, Region I

For the purpose of informing affected employees, copies of this report shall be posted by the employer in a prominent place accessible to the employees for a period of 30 calendar days.

TABLE I

Clincial Parameters in the Study Population

Subject	Physical Exam	Hemoglobin/Hematocrit	White Count/Differential	Platelets	B^{12}	Folate
1.	Small inguinal nodes remainder normal	16.2/46.2	6,600 61 seg/4 band	230,000	440 pg/ml	3.8 ng/l (serum)
2.	Normal	15.0/43.7	8,400 59 seg/32 lymph 7 mono/2 eo	280,000	610 pg/ml	315 ng/ml (red cells)
3.	Congenital ear malformation	14.7/42.7	4,200 72 seg/23 lymph 5 mono	190,000	660 pg/ml	271 ng/ml (red cells)
4.	Normal	16.7/47.1	5,000 72 seg/2 band/ 17 lymph/1 eo 2 meta	220,000	640 pg/ml	2.4 ng/ml (serum)
5.	Small inguinal nodes	16.1/44.9	4,000 61 seg/4 band/ 24 lymph/10/mar 1 baso	170,000	530 ng/ml	5.8 ng/ml (serum)
6.	Normal	14.3/40.8	4,500 53 seg/2 band 29 lymph/10 mono 6 eo	200,000	650 ng/ml	30.0 ng/ml (serum)
7.	Normal	14.4/40.6	5,300 53 seg/1 band 15 mono/25 lymph 1 bas/1 atypical lymph	180,000	390 ng/ml	7.4 ng/ml (serum)

Subjects 1-5 - High exposure category
6,7 - Low exposure category

TABLE II

Findings On Bone Marrow Biopsy In The Study Population

Subject	Cellularity	Myeloid Erythroid Ratio	PAS Positive Stromal Tissue	Iron Deposition	Additional Findings
1.	20%	1:2	present	mod. increase with ring sideroblats	
2.	60-70%	1.5:1	absent	mod. increase	moderate eosinophils slight plasma, mast cells
3.	30%	1:1	present	mild increase	slight eosinophils
4.	30%	1:1.5	absent	mild increase	slight eosinophils, plasma cells, mast cells
5.	25%	1:2	present	marked increase with ring sideroblasts	slight eosinophils, plasma cells, mast cells
6.	30%	1:1	absent	mild increase	slight eosinophils, mast cells, plasma cells, lymphocytes
7.	40%	1:3	absent	mild increase macrophages	numerous cytophagocyte

TABLE III

Bone Marrow Findings In Melanoma 'Controls'

Subject	Cellularity	Myeloid Erythroid Ratio	PAS Positive Stromal Tissue	Iron Deposition	Additional Findings
8.	20%	2:1	present	slight increase	Moderate eosinophils, plasma cells, mast cells
9.	50%	3:1	absent	normal	moderate eosinophils
10.	25%	1:5	present	absent	moderate lymphocytes
11.	60%	1:1	absent	absent	marked eosinophils
12.	25%	1:2	present	absent	moderate eosinophils
13.	25%	1:2	present	decreased	slight eosinophils, mast cells, plasma cells
14.	30%	1:2	present	mod. increased	megaloblastic changes
15.	50%	1:3	present	slight increase	eosinophils, mast cells, plasma cells, lymphocytes
16.	45%	1:2	absent	mod. increase, few ring sideroblasts	moderate lymphocytes
17.	50%	2:1	absent	slight increase cytophagocytosis	macrophages with
18.	20%	1:1.5	present	decreased	immature myeloid series