BIOMEDICAL AND ENVIRONMENTAL SCIENCES **15**, 268-270 (2002)

Study on Chromosome Damage Among Nurses Occupationally Exposed to Antineoplastic Drugs in an Oncology Department

YANG DONG-PING[*], XU SHI-JIE[△], WANG JIAN-XIN[△]

[*]Medical School, Jiaxin College; [△]Department of Oncology, the First Affiliated Hospital of Medical School of Jiaxin College, Jiaxin, Zhejiang 314001, China

INTRODUCTION

Many antineoplastic agents have been shown to be mutagenic, teratogenic and carcinogenic in experimental animals and *in vitro* test systems. Epidemiological data on the association of secondary neoplasms with a specific chemotherapeutic treatment are available on some 30 agents. Several previous studies concerning hospital personnel have indicated that occupational exposure to cytostatic drugs may be detected by genotoxicological biomonitoring methods, e.g., comet assay, SCEs, chromosomal aberration and micronucleus test. However, various studies reported both positive and negative results which were contradictory. The conflicting results may be explained by differences among the studies in the degree and duration of exposure. The evidence so far suggested that increased SCEs have a relatively short duration, while structural damage observed as CAs may persist for years. Meanwhile, the cytokinesis-block micronucleus (CBMN) method has the advantages of precision, simplicity, rapidity and sensitivity. For this reason, the chromosomal damage of 16 nurses occupationally exposed to antineoplastic drugs in an oncology department was detected with chromosomal aberration and CBMN in this study.

MATERIALS AND METHODS

Subjects: The exposure group: 16 no-smoking female nurses occupationally exposed to antineoplastic drugs (average age of 29 years; average exposure-duration: 5.5 years; exposure to average 8.25 chemotherapeutic preparations daily) were working in an oncology department. Sixteen no-smoking females controls were from a Nursing School who were never exposed to any antineoplastic drugs.

Methods: Heparinized whole-blood samples (0.4 mL) were added to 4.6 mL of RPMI 1640 (Sigma) containing 20% fetal calf serum, with 0.2 mg/mL phytohemagglutinin (PHA) and antibiotics (100 IU penicillin and 0.1 mg/mL streptomycin). Two independent cultures were set up for CA and MN scoring. For CA analysis and MN analysis, the cultures were

Biographical note of the first author: Yang Dong-Ping, male, born in 1944, associate professor of preventive medicine, majoring in occupational hygiene.

0895-3988/2002
CN 11-2816

incubated at 37℃ for 48 h and 72 h, respectively. Colchicine was added to cultures (0.01 mg/mL) 2 h before harvesting CA. Metaphases were prepared according to conventional methods, and slides were stained by Giemsa Staining. MN was analyzed in cell cytokinesis which had been blocked by Cytochalasin B (Cyto-B,4.5 μg/mL, Sigma) for 28 h before harvesting. Cells were then processed according to the method described and modified to make the use of whole-blood cultures possible. One hundred metaphases and 1000 binucleated (BN) lymphocytes were scored for the presence of CA and MN respectively. Statistical analysis was made using Rank-sum test after finding the heteroscedasticity of the data.

RESULTS

Table 1 shows the results of binucleated lymphocyte MN assay in the peripheral lymphocytes from 16 nurses occupationally exposed to antineoplastic drugs and 16 controls. In the exposure group the arrangement of micronucleus rate was 8‰-24‰, while in control group the arrangement of micronucleated cell rates was 2‰-7‰. The mean micronucleated cell rate in the exposure group was 15.06‰±5.30‰,which was significantly higher than that (4.56‰±1.67‰) in the control group (P<0.01).

Table 1 also shows the results of chromosomal aberration test in the peripheral lymphocytes from 16 nurses occupationally exposed to antineoplastic drugs and 16 controls. Chromosome structure aberrations observed were mainly chromatid breakage, chromosome breakage, deletion and fragments. In the exposure group the arrangement of chromosomal aberration rates was 1‰-13%, while in the control group the arrangement of chromosomal aberration rates was 0‰-3%. The mean chromosomal aberration rate in the exposure group was 6.38‰±3.30%, which was significantly higher than that (1.25±0.93) in the control group (P<0.01).

DISCUSSION

Several previous studies concerning hospital personnel have indicated that the increased frequencies of SCEs, chromosomal aberrations and micronuclei in the blood lymphocytes of oncology nurses than the controls. Also negative results were reported in similar occupational exposure studies. The conflicting results may be explained by differences among the studies in the degree and duration of exposure. In the present study, the results of chromosomal aberration (CA) test indicated that the CA rate of exposure group appeared to be significantly increased when compared with the controls. The results of micronucleus (MN) test showed that the MN rate of exposure group was significantly higher than that of the controls. This study may interpreted that chromosome of nurses occupationally exposed to antineoplastic drugs was injured.

Nurses handling antineoplastic drugs can be exposed through inhalation of aerosolized drugs, transdermal absorption since contamination may occur during the reconstitution of parenteral antineoplastics during the normal process of excess-drug disposal or as a result of vial leakage, or accidental spill. Therefore, it is important for nurses of oncology department to take the safety guidelines for handling antineoplastics, for example, protective clothing and equipment for mixing and administering the drugs, cleaning up spills, and handling excreta of cancer patients. The result of a study showed a 50% higher level of DNA strand breaks was detected in nurses not using recommended safety precautions but in nurses,

using adequate safety equipment , no significant differences were found.

TABLE 1

The Exposure Duration, MCPD, Micronuclei and Chromosomal Aberrations in the Exposure and Control Groups

Group	Exposure Duration (Year)	MCPD	Micronucleus Test		Chromosomal Aberrations in 100 Metaphases				
			Number of Cells scored	Number of Micronucleated Cells	CB	cb	D	F	Total
Exposure group									
1	7	11	1000	20	7				7
2	9	10	1000	12	4		1		5
3	16	5	1000	8	3				3
4	5	8	1000	9	1				1
5	4	8	1000	18	3		2	1	6
6	8	6	1000	20	3				3
7	5	8	1000	18	4	1		2	7
8	3	11	1000	15	7	1			8
9	1	11	1000	14	7	6			13
10	1	8	1000	20	4	5		1	10
11	1	9	1000	24	4		1	2	7
12	1	12	1000	17	10	1		1	12
13	4	6	1000	8	3				3
14	6	3	1000	8	4	3			7
15	6	8	1000	20	2	1	2		5
16	11	8	1000	10	5	1			6
Average	5.5	8.25	1000	15.06±5.30*					6.38±3.30*
Control group									
1	0	0	1000	7	2				2
2	0	0	1000	4	3				3
3	0	0	1000	7	1				1
4	0	0	1000	3	1				1
5	0	0	1000	4	1			1	2
6	0	0	1000	3	3				3
7	0	0	1000	4	0				0
8	0	0	1000	6	2				2
9	0	0	1000	5	0				0
10	0	0	1000	6	1				1
11	0	0	1000	5	1				1
12	0	0	1000	2	1				1
13	0	0	1000	2	0				0
14	0	0	1000	6	2				2
15	0	0	1000	3	1				1
16	0	0	1000	6	1				1
Average	0	0	1000	4.56±1.67					1.25±0.93

Note. MCPD: mean chemotherapeutic preparations daily; CB: chromosome breakage; cb: chromatid breakage; D: deletion; F: fragment. *Compared with controls $P<0.01$.

(*Received October* 10, 2001 *Accepted June* 5, 2002)