〈論　　文〉

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A Study on the Health Effect of Air Pollution among the Express-way Tollgate Workers in Seoul

대기오염이 고속도로 톨게이트 근무자의 건강에 미치는 영향

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대기오염이 인체에 미치는 영향을 연구하기 위하여 오염의 농도가 지극히 심할 것으로 예측되는 고속도로 서울톨게이트에 근무하는 근로자 37명과 사무직 15명을 대상으로 혈액 및 요중 납함량과 요중 코프로포르피린을 정량하고 임파구 중 자매염색분체 교환빈도를 계산하여 인적특성에 따라 비교 검토하였다. 한편 대기오염의 정도를 파악하고자 1986년 4월부터 약 3개월에 걸쳐 아황산가스, 이산화질소, 일산화탄소, 부유분진, 납, 벤조파이렌 등 인체에 유해한 오염물질들을 톨게이트 근무자가 근무하는 위치의 공기 중에서 정량하였다.

이들 성적을 비교 검토한 바 다음과 같은 결론을 얻었다.

1. 톨게이트 내의 공기 중 이산화질소, 일산화탄소, 부유분진, 벤조파이렌, 납량 등이 서울시내 일반대기보다 월등히 높았다.
2. 톨게이트 근로자의 혈중 납량, 요중 납 및 코프로포르피린량, 그리고 임파구 내의 자매염색분체 교환빈도의 평균치가 사무직근로자보다 유의하게 높았다.

INTRODUCTION

For the very large majority of environmental agents to which man is exposed, we have no idea on the degree that they influence risk of cancer or mutation. Nevertheless some researches by foreign scientists of developed contries indicate that chemical and physical agents encountered in the occupational environment may be an important class of human carcinogens and mutagens, not only because of the disease produced among workers but also because many occupational exposure find their way into the general environment.[1)]

Actually, mutagenicity screening program for human may be most useful component of prevention both in its own light as a guide to cancer control and as a crucial data base for determining the predictive value of experimental carcinogenicity and mutagenicity testing.[2)]

The increasing recognition of the need for a

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systematic approach to environmental carcinogenesis and mutagenesis has led to methods based on occupational title-based case-control studies. These approaches are in increasing order of likelihood of providing useful results.[1] The most recent application of short-term assays for genotoxic activity has been in the disciplines of environmental and human monitoring. Tests such as the Ames microbial reverse mutation assay and the sister-chromatid exchange (SCE) technique have been used extensively to assess the genotoxic activity of water, air and food supplies.

More recently, SCEs have been used in several countries to supplement chromosome analysis since this technique often gives better resolution and can detect effects that might otherwise go undetected.[3]

Here in Korea, however, SCEs have not been used to evaluate mutagenicity of any chemicals whether by processed or unprocessed samples. In this study, it aimed at evaluating mutagenic effect of polluted air by automobile exhausted gas around tollgate measuring SCEs in blood of tollkeepers.

Additionally, air quality of check points was also evaluated, to be compared with SCE data. Lead contents of tollkeepers' blood are also compared with lead contents of the air.

MATERIAL AND METHODS

This study was conducted to evaluate air quality polluted due to automobile exhausted gas around the Seoul tollgate, the entrance of Seoul-Pusan Express Highway which was passed through by more than 40,000 vehicles a day. And also for the evaluation of health effects of tollkeepers caused by polluted air around them, biological indices of lead exposure and presence of sister chromatid exchange on the peripheral lymphocytes (SCE/cell) of 37 selected tollkeepers were examined.

The data were compared with those of 15 non-exposed workers. As air pollution indices, concentration of total dust, respirable dust, 3,4 benzo(a) pyrene (BAP), SO_2, NO_2, and CO were measured during 3 months from April 1986. Informations of workers' characteristics such as age, career, smoking and drinking habits, and of others were also analyzed.

RESULTS AND DISCUSSION

No typical symptoms and signs were detected at the physical examination.

Concentrations of gaseous chemicals such as SO_2, NO_2 and CO were below the permissible limit in case of ambient air whereas those of NO_2, CO were higher than the average concentration of those in Seoul area in 1984 (Table 1). However, the concentration of TSP was very much higher than the limit value of 300 $\mu g/m^3$. It was also higher than the concentration range of TSP in Seoul area in 1984.

Table 1. Concentration of some pollutants

Pollutant	Range	Permissible limit (Ambient air)	Reference data ('84. Seoul in average)
SO_2	0.03-0.05ppm	0.15	0.06
NO_2	0.05-0.08ppm	0.15	0.03
CO	7.25-8.82ppm	20.0	2.63
TSP	340-1,264$\mu g/m^3$	300	*129-263

* Range

Table 2 shows the concentration of Pb and BAP in particulates around the tollgate. For the particulates, proportion of respirable dusts smaller than 5μm in diameter among TSP was about 60% of all. Furthermore, it was revealed that percentage of

Table 2. Concentration of some particles

Particles	Concentration
Total suspended particle	340 - 1,264 $\mu g/m^3$ ($\bar{x}$: 562,100.0%)
Respirable particle	37 - 441 $\mu g/m^3$ ($\bar{x}$: 341, *60.0%)
Pb in total suspended particle	1.91 - 1.33 $\mu g/m^3$
Pb in respirable particle	1.56 - 0.86 $\mu g/m^3$
BAP** in respirable particle	0.10 - 13.88 ng/m^3

* Percentage to the total suspended particulate
** BAP; Benzo(a)pyrene

dusts smaller than 2.0μm in diameter was about 40% of total. Coincidentally, it was also found that there was not much differences between the lead concentrations in total suspended particle and respirable particle. Finally, it was revealed that range of BAP concentration was very wide from 0.10 to 13.88 ng/m^3. Highest concentration was detected when traffic was jamed. On the other hand it was lowest at night. Comparing with the other reference data[4] which showed lower concentration than 5.67ng/m^3 in Seoul. It was said to be comparatively higher around tollgate. And so, it was thought to be worthwhile to check whether the workers were poisoned to lead and whether mutagenic sign appeared.

Happily, it was possible for us to collect blood and urine samples from a total of 37 workers who have worked as the tollkeepers and to interview. On the other hand, same kinds of specimens were collected from 15 workers who have not been involved in toll work at all.

Table 3. Mean values from blood and urine examination

$\bar{x} \pm SD$

	Career (yr)	Pb-B ($\mu g/d\ell$)	Pb-U ($\mu g/\ell$)	Copro ($\mu g/\ell$)	SCE/cell
Exposed (37)	3.0±1.53	35.96±14.38	53.23±56.93	107.84±66.24	8.34±1.53
N-exposed (15)	0	24.10±18.70	23.10±27.10	39.20±79.00	6.44±0.86

$p < 0.05$

Table 3 shows average values concerning lead poisoning and mutagenic changes of 37 tollkeepers as exposed group and 15 nonexposed group to be compared. Hemoglobin and hematocrit values showed within normal limit throughout entire samples. However, of tollkeepers, all the mean values, such as concentrations of lead in blood and urine, coproporphyrine in urine and SCE per lymphocyte were significantly higher than those of workers not exposed.

There are many indices to diagnose lead poisoning as we know. Among them, Pb-blood and coproporphyrine were found to be most sensitive. This schematic drawing shows the proportions of tollkeepers whose blood Pb and urine coprophorphyrine levels were higher than normal limits of 40$\mu g/d\ell$ and 100 $\mu g/\ell$ each. Actually, it reveals that 43.2% (16 persons) of the total tollkeepers have normal levels of Pb-blood and coproporphyrine. Higher level of Pb-blood was found in 35.1% and of coproporphyrine also in 35.1%. Higher levels of both the Pb-blood and coproporphyrine at the same time was found in 13.5% of total workers (Figure 1). This made us conclude that at least 13.5% of the total tollkeepers of Seoul Express Tollgate were suspicious of lead poisoning and that it was caused of lead in air polluted by automobile emission around the tollgate.

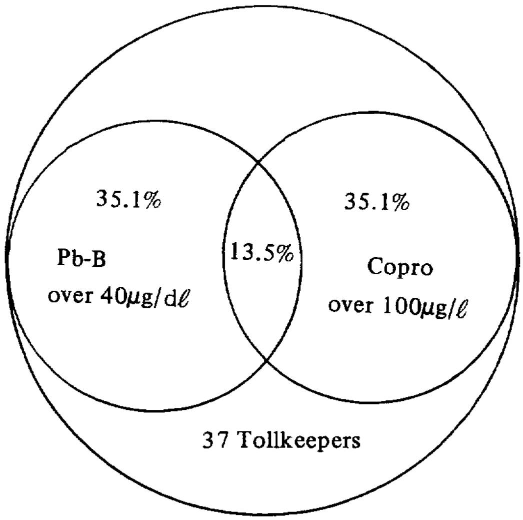

Figure 1. Proportion of workers showing abnormally high values of lead poisoning indices

As well known, 3-4 BAP was proved to have carcinogenicity and probably mutagenicity and teratogenicity. In light of this view, SCE/cell in peripheral blood was studied. Figure 2 shows the results schematically. However, it is very hard to clarify the normal range of SCE/cell. Frequency of SCE depends mainly on four factors of (1) concentration of BUdR (2) kinds of culture media for cell division and (3) duration of culture etc. In the Table 4, the mean frequency of normal persons was from 4.41 to 14.0[5-14] So, it was necessary to establish normal range of SCE/cell for comparison. Temporarily, we defined normal limit to be less than mean+2xSD of normal people who have never been exposed to teratogenic materials theoretically. In this study it was 8.16 of SCE/cell (6.44+2x0.86). Then, it may be said that 56.8% of total tollkeepers had more of SCE/cell than normal range of control group. And also the mean SCE/cell of tollkeepers, 8.34+1.53, could be said to be significantly higher than that of control, 6.64+0.86 (Figure 2).

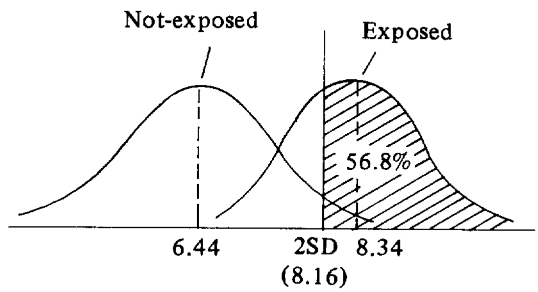

Figure 2. Distribution of means SCE/cell

Table 4. Frequency of SCE/cell of normal persons by research

Method	Duration of culture	Culture media	BUdR	SCE/cell	Reporter
micro	72hrs	Parker 199	20µM	8.08	Wulf HC et al[5]
micro	60-70hrs	RPM 11640	20µM	8.46±0.22	Livingston GK et al[6]
micro	72hrs	Parker 199	20µM	8.25±0.13	Wulf HC et al[7]
micro	60-70hrs	RPM 11640	20µM	7.79±0.49	Rom WN et al[9]
micro	72hrs	Parker 199	10µM	4.79	Obe G et al[10]
micro	72hrs	–	20µM	4.41±0.72	Meiying C et al[11]
micro	72hrs	RPM 11640	3µM	10.56±0.40	Camurri L et al[12]
macro	72hrs	Parker 199	100µM	14.00±0.45	Lambert B et al[13]
macro	72hrs	F 10	17µM	10.02	Crossen PE et al[14]

With this phenomena, the authors concluded that air polluted by automobile exhaustion started increasing the number of SCE/cell of some tollkeepers. With correlation study of Pb-lead and SCE performed with independant variables of career, smoking amount, and of others, except the correlation coefficient of 0.46 between career and Pb-blood, there was no remarkable correlation among each variables.

CONCLUSION

According to the blood examination of some tollkeepers having worked in Seoul Express Highway Tollgate, air polluted by automobile exhaustion increased the mean number of SCE/lymphocyte and concentration of lead in blood and urine, and coproporphyrine of the tollkeepers.

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