ESTIMATION OF CYTOGENETIC RISK IN THE PROCESS OF NON-DESTRUCTIVE TESTING OF WELDS

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INTRODUCTION

In the process of non-destructive testing of welds the workers are very often exposed to both X-ray or gamma radiation and ultrasound , in dependence with the requirements of the test method applied.Despite training courses and awareness of workers that protection is necessary in the USA has been developed a special audit program for assuring radiation safety during radiographic examination operations (1). Such program can be actually implanted in every company which is licensed for weld testing activities. The advantage of this program is also that the number of radiographic inspections is controlled in order to prevent possibility of accidental exposures as the results of fatigue (2).

The estimation of dose based on chromosomal aberration analysis is a relible and generally accepted method, and it indicates genome damages earlier than any other method used in medicine. However, according to available literature data it could be seen that in the cases of overexposure of radiographers detected by film dosimeter only skin changes are quite often diagnosed even without heamatologocal analysis (3). Since no biodosimetrical study so far provides data on genome damages of radiographers caused by combined exposure to gamma irradiation and ultasound the aim of this study was to compare the effects of the exposure to ionizing radiation alone and combined with application of ultrasound during the process of weld testing.

SUBJECTS AND METHODS

Twenty three industrial radiographers working on testing of welds for an average of 10 years were chosen for cytogenetic examination.During radiography examinees used the ^{192}Ir source of ionizing radiation which had activity of 1,85 TBq.In the case of application of ultrasound the frequency ranged from 0,1MHz to 35 MHz.A control group included 20 male subjects from the general population, aged 35-45 years old. Among radiographers and control group those with recent X-ray exposure for diagnostic purposes and drug treatment were excluded from the study. Examined subjects did not exceed permited annual dose of 50 mSv measured by film dosimeter.

The chromosome aberration assay was carried out on the cultures of phytohemagglutinin-stimulated blood lymphocytes. Fixation of cultures and preparation of slides were carried out according to conventional methods (4).Two hundered well-spread and complete metaphases were analyzed for every person and results are presented as percentages.

RESULTS AND DISCUSSION

A group of 23 subjects occupationally exposed to ionizing radiation and ultrasound during the process of non-destructive control of welds was analysed using the cytogenetic method of chromosome aberration assay. The number of structural chromosome aberrations such as dicentric, ring, triradial and tetraradial chromosomes was significantly increased in exposed subjects compared to the control group. Table 1 shows that the frequency of unstable chromosome aberrations such as dicentric, triradial and tetraradial chromosomes are more frequent in cases of combined exposure to ionizing radiation and ultrasound than ionizing radiation alone.This finding corresponding with the data pertaining to occupational exposure to ultrasound emphasizes the importance of acceptaning and considering the ultrasound as a source of radiation with possible health consequences (5).

It can be concluded that in cases of combined occupational exposure estimation of dose received by radiographers using film dosimetry should be accompanied by cytogenetic monitoring because personal dosimeter for ultrasound has not been constructed yet.In order to minimize health risk biomonitoring can detect possible synergistic action of both ultrasound and ionizing radiation which is not measurable by any physical method.

IONIZING RADIATION

Subject	Chromatid break %	chromosome break %	acentric fragment %	dicentric %	tetraradial %	triradial %
1	1,5	0,5		0,5		
2	1,5	0,5	1			
3	0,5	0,5				
4	0.5					
5		0,5				
6	1,5	1,5				
7	1,5	1				
8	0.5	1				
9	0.5	1,5				
10	1	0,5				

IONIZING RADIATION + ULTRASOUND

Subject	Chromatid break %	chromosome break %	acentric fragment %	dicentric %	tetraradial %	triradial %
1	0.5	1,5				
2	1	1,5	0,5	0,5		
3	0,5	1	1	0,5		
4	0.5	1,5	1		0.5	0,5
5	0.5	1	1			
6	0.5	1,5	0.5			
7	0.5	1	0.5			
8		1,5				
9	1	0,5				
10	1	0,5				0,5
11		1				
12	0,5	0,5	0,5	0,5		
13	0.5	2	2	2		
control values	0.8	0.6	0.7			

Table 1. Comparison between chromosome aberrations of radiographers exposed on their working places to ionizing radiation and chromosome aberrations of radiographers exposed to combined action of ionizing radiation and ultrasound

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