THE IMPORTANCE OF RADIATION AND NON-RADIATION-FACTORS FOR THE STOMACH CANCER INCIDENCE IN WORKERS OF THE ATOMIC PLANT MAYAK

Galina V. Zhuntova[1], Z.B. Tokarskaya[1], N.D. Okladnikova[1], Z.D. Belyaeva[1], E.G. Drozhko[2]

[1] The Inst. of Biophys. Branch No 1, Ozyorsk, Russian Federation, 456790
[2] Prodaction Association Mayak, Ozyorsk, Russian Federation, 456790

INTRODUCTION

Stomach cancer is one of the most widespreaded oncological diseases among the men. It is known about the increase of stomach cancer incidences and mortality among the A-bomb surviders (1) as well as among the professionals subjected to the chronic exposure to external gamma-irradiation and internal exposure due to body burden 239 Pu of high doses (2). Inasmuch as this disease is polyetiological, the determination of non-radiation factors contribution is important for more accurate estimation of the effect of ionizing radiation on its advent and for its more successful prophylaxis. With this in mind a retrospective investigation of the personal of the atomic plant MAYAK was conducted, who start their work in 1948 to 1960.

MATERIALS and METHODS

503 workers of the atomic plant MAYAK were examined that were subjected to external chronic gamma-irradiation with the total dose of 0 to 8,46 Gy and body burden ^{239}Pu 0 to 39,6 kBq. The data on individual external gamma-irradiation doses were presented by enterprise monitoring survice and data on body burden ^{239}Pu by biophysic laboratory of Branch No 1 of Biophysic Institute (the chief of the laboratory is Dr. V.F.Kchochryakov). From 1955 to 1992 stomach cancer was diagnosed by 157 persons (141 men and 16 women) morphologically confirmed (autopsy and biopsy during surgical operation). 346 persons (313 men and 33 women) without cancer served as pair control, matched on sex, age (±5 years), beginning of the work at the plant (±2 years) and profession. Besides radiation factors the effects of medical, biological and social factors were studed influencing the development of this disease (table 1). The data about the smoking and alcohol taking were received from individual interviews. The contribution of studed factors to stomach cancer incidences was estimated by odds ratio (Or_{cr}-odds ratio crude and Or_{ad} - odds ratio adjasted), calculated on base of the model of multiple logistic regression. Attributable risk (AR) was calculated for statistically significant factors, that allows to determine what part of the investigated cancer incidences is subjected to the each factor. Statistic programms SAS and BMDP were used.

RESULTS AND DISCASSION

The mean values of total and maximum doses of chronic external gamma-irradiation in the main and in the control group were significantly not different, but the part of persons with the total external gamma-dose more than 3 Gy was significantly higher in the main group (table 1). No important differences were noted between the main and the control group in ^{239}Pu content in the organism and in the frequency of previous professional contacts with chemically dangerous substances.

A significant increase of current smoker part and smoking index value was noted in the main group but in the control group the part of exsmokers was increased. The age of start smoking was the same in both groups, there were no differences in alcohol taking.

The differences in constitution between the main and control groups were characterized by mass index decrease of persons in the main group some years before tumor diagnose. The frequency of chronic hypocidity and anacidity gastritis, colitis, gallbladder diseases was significantly higher in the main group. The percent of stomach and duodenal ulcers was the same in the both groups, but there were differences in ulcer localization. The mean age of the persons fallen ill with cancer was 51.2±0.8 years and the period from the begin of the contact with ionizing radiation up to tumor diagnose was 22.1±1 years.

Table 1

COMPARISION OF STOMACH CANCER CASES AND NON-MALIGNANT CONTROL

	Risk Factors		Mean or percentage ± error		"P" value
			case	control	
			n = 157	n = 346	
	Matched variables				
1	Sex (% men)	%	89,8 ± 2,4	90,5 ± 1,6	> 0,05
2	Years of birth	yr	1924,0 ± 0,8	1925,5 ± 0,5	> 0,05
3	Age of work's start	yr	29,2 ± 0,6	28,1 ± 0,4	> 0,05
4	Part of worker's profession	%	79,6 ± 3,2	76,3 ± 2,3	> 0,05
	Professional factors				
5	Total external γ-irradiation	Gy	126,9 ± 13,6	104,3 ± 5,9	> 0,05
6	Total external γ-irradiation > 3 Gy	%	12,7 ± 2,7	5,8 ± 1,3	< 0,01
7	Maxim.. years rate γ-irradiation	Gy	48,4 ± 6,7	35,7 ± 2,6	< 0,1
8	^{239}Pu body burden	kBq	1,32 ± 0,32	0,76 ± 0,11	< 0,1
9	Previous professional contacts with chemically dangerous substances	%	14,0 ± 2.8	8,4 ± 1,5	< 0,1
	Social factors				
10	Smoking: current smoker	%	62,4 ± 3,9	44,8 ± 2,7	< 0,001
	exsmoker	%	13,4 ± 2,7	27,2 ± 2,4	< 0,001
	never smoker	%	24,2 ± 3,4	28,0 ± 2,4	> 0,05
11	Age of smoking's start	yr	17,5 ± 0,6	17,6 ± 0,8	> 0,05
12	Smoking's index	cig/d	700,0 ± 37,8	559,0 ± 22,1	< 0,01
13	Alcohol taking: regularly	%	22,3 ± 3,3	17,6 ± 2,0	> 0,05
	occasionally	%	57,3 ± 3,9	57,5 ± 2,7	> 0,05
	rarely	%	20,4 ± 3,2	24,9 ± 2,3	> 0,05
	Medical and biological factors				
14	Body height	cm	169 ± 0,6	169 ± 0,4	> 0,05
15	Body weight	kg	70,4 ± 0,8	72,5 ± 0,5	< 0,05
16	Quetlete's index	kg/m²	24,6 ± 0,3	25,5 ± 0,2	< 0,05
17	Chronicle hypoacidity gastritis	%	18,5 ± 3,1	8,4 ± 1,5	< 0,01
18	Chronicle anacidity gastritis	%	26,8 ± 3,5	6,4 ± 1.3	< 0,001
19	Chronicle hyperacidity gastritis	%	1,9 ± 1,1	3,8 ± 1,0	> 0,05
20	Stomach and duodenal ulcer:	%	11,5 ± 2,5	11,0 ± 1.7	> 0,05
	stomach ulcer	%	7,6 ± 2,1	0,3 ± 0,3	< 0,001
	duodenal ulcer	%	3,8 ± 1,5	10,7 ± 1,7	< 0,01
21	Stomach polyps	%	2,5 ± 1,3	0,3 ± 0,3	<0,1
22	Chronicle colitis	%	12,7 ± 2,7	6,6 ± 1,3	< 0,05
23	Gallbladder diseases	%	24,8 ± 3,4	14,5 ± 1,9	< 0,01

The influence of 13 potential risk factors on stomach cancer incidence were studied by multiple analysis based on logistic regression model. 5 significant factors were resolved, OR_{ad} was calculated for each of them (table 2): for the external gamma-irradiation with the total dose more than 3 Gy OR_{ad} = 2,1; for anacidity gastritis OR_{ad} = 8,0; for hypoacidity gastritis OR_{ad} = 5,2; for current smokers relative exsmokers and never smokers OR_{ad} = 2,7 (table 2). By the calculation of attributable risk it was shown that among all studied cancer incidence only 5% were cased by external gamma-irradiation with the dose more than 3 Gy; the main

part of cancer incidences - 29 % is connected with chronicle stomach disease and 24% of them are caused by current smoking.

Besides the study of independent influence of different factors on cancer incidences the evaluation of their interaction is made. In this case it was noted that the interaction between external gamma-irradiation with the total dose more than 3 Gy and gastritis is

Table 2.

DEPENDENCE of STOMACH CANCER of VALUE DIFFERENT RISK FACTORS

| Factors | Range | Frequency (n) | | OR_{cr} | OR_{ad} | | AR and |
		case	control		Point est	95% CI	95% CI
Total external γ-irradiation (Gy)	0-3	137	326	2,4*	2,1	1,01-4,4	5,2%
	> 3	20	20				(0,7%-9,4%)
Hypoacidity gastritis	no	128	317	2,5**	5,2	2,45-11,0	7,8%
	yes	29	29				(2,3%-13,0%)
Anacidity gastritis	no	115	324	5,4**	8,0	4,4-14,6	16,1%
	yes	42	22				(9,7%-22,0%)
Stomach ulcer	no	145	345	28,6*	41,2	5,2-328	5,1%
	yes	12	1				(2,1%-8,2%)
Stomach polyps	no	153	345	9,0			
	yes	4	1				
Noncurrent smoker		59	191	2,0**	2,7	1,7-4,3	24,4%
Current smoker		98	155				(10,3%-36,3%)
Alcohol	irregularly	122	285	1,3			
taking	regularly	35	61				

*- P < 0.05 , ** - P < 0,01

submultiplicative and the interaction between gamma-irradiation and smoking, alcohol taking is multiplicative.

In such a way as a result of the conducted study it was determined, that the chronic external gamma-irradiation causes the statistically significant increase of stomach cancer incidences by the total dose more than 3 Gy. It is known, that the significant increase of cancer risk by the dose more than 200 rad was noted by the A-bomb survivors in the group with the age of irradiation moment that corresponded to the age of MAYAK workers at the moment of the first contacts with ionizing radiation /1/.

Among the examined persons more higher probability of cancer incidence was noted for current smokers relative to never smokers and exsmokers and the value of smoking index hadn't any great importance, that is the main importance had just the fact of current smoking. The data from references on this problem are different but the many authors doesn't find correlation between the stomach cancer and smoking. In our case cheap sorts of papirosen with high content of toxic substances and without filter were taken chiefly and just that fact could promote cancer. It was not found direct correlation between stomach cancer and alcohol taking. This is in accordance with literature data but it must be noted, that the examined persons could give incorrect information from social reasons about the quantity of alcohol taking, specially lowing it.

The most high probability of stomach cancer was noted among the workers with chronicle stomach diseases. In this connection we are studying now the problem on the possible influence of ionizing radiation on the incidence of them and , if such an influence will be confirmed, the stimation of the contribution of ionizing radiation to the stomach cancer incidences among the personnel could be changed.

REFERENCES

1. H. Matsuura, T. Yamamoto, I. Sekine, et al., *Technical report RERF, TR* 12-83, 22 (1983).
2. G.S. Moroz, N.Y. Kabasheva, *Bul. Rad. Med.* 1, 57-62 (1974).

FORM FOR SUBMISSION OF ABSTRACTS
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PAPER TITLE _Evaluation of health impacts in human chronic low dose, low dose rate r-irradiation exposure._

AUTHOR(S) NAME(S)

Chang WP, Wang D, Wang JC, Hwang BF, Chan CC, Hwang JS, Wang JD.

SUBMITTING AUTHOR

LAST NAME _CHANG_   FIRST NAME _Wushou_   TITLE _Asso. Professor_

AFFILIATION _National Yang Ming University Medical School_ TEL _(886) 2-8267053_

STREET _155, Lih-long St. Shih-pai, Taipei_   FAX _(886) 2-8221942_

CODE   CITY _Taipei_   COUNTRY _Taiwan_

PRESENTING AUTHOR (IF DIFFERENT)

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ABSTRACT (See instructions overleaf)

EVALUATION OF HEALTH IMPACTS IN HUMAN CHRONIC LOW DOSE, LOW DOSE
RATE γ-IRRADIATION EXPOSURE.
Chang WP, Wang D, Wang JC, Hwnag BF, Chan CC, Hwang JS, Wang JD.

More than 6,000 residents and primary school or kindergarten
students in Taiwan have been identified to have received
continuously excessive low dose γ-ionizing radiation (cumulative
0.5 to 100 rems) from various environmental sources, including
radioactive apartments and radioactive classrooms containing Co-
60 contaminated steel rebars or window frames, since 1983 to
1995 (Lancet, 342:1544). Several correlated studies have been
undertaken in order to understand the health effects of such
exposure in human, including exposure dose assessment by the
time-activity-based environmental monitoring (a joint program
with the National Institute of Occupational Safety and Health,
U.S.A.), a systemic and comprehensive medical surveillance
program, the growth and development evaluation in children borne
and grown up in the apartments, and the cytogenetic monitoring
in their peripheral lymphocytes. The risk of various health
effects will be demonstrated and compared with those of current
risk coefficients employed by the International Commission on
Radiological Protection(ICRP). This report will be an update of