

CYTOGENETIC EFFECTS IN CHILDREN BORN TO PARTICIPANTS IN THE
CLEANUP OF THE CHERNOBYL ACCIDENT CONSEQUENCES —
ACUTE RADIATION SYNDROME SURVIVORS AND
CHILDREN EVACUATED FROM PRIPYAT

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ABSTRACT

The cytogenetic study of 87 children was held. Age of involved kids ranged from 5 to 14 years old. The I-st study group was presented with 17 kids born in 1987-1988 from the Chernobyl accident consequences cleaning up participants (CACCP) who survived the Acute radiation syndrome (ARS) of I - II severity degree in 1986. The II-nd study group was consisted from the 45 children born in 1983 - 1985 resident in town Pripyat with thyroid exposure doses from 65 to 616 sZv and total irradiation doses from 0.2 to 13.2 sZv. The 25 children born in 1983 - 1988 and resident in radiation situation - favourable region of Ukraine constituted the Control (III-rd) group.

The aberrant cells number and chromosomal aberrations amount mainly due to chromatide type ones confidential increase compared to that in control was revealed among the children born from CACCP - ARS servivors.

In children exposed to ionising radiation during infant and early childhood age the aberrant cells number and chromosomal aberrations quantity was elevated also but due to both chromosomal (dicentrics and rings) and chromatide types.

INTRODUCTION

The chromosomal apparatus status study represents one of Chernobyl disaster actual medical aspects for radiation effection bioindication both with feasible stokhastic and non-stokhastic effects risk estimation [1]. The children are of particular interest here as the most sensitive to radiation factor effection part of the survived population [2].

MATERIALS AND METHODS

The 87 children age from 5 to 14 years old were inviolved. The I-st study group was presented with 17 kids born in 1987-1988 from the Chernobyl accident consequences cleaning up participants (CACCP) who survived the Acute radiation syndrome (ARS) of I - II severity degree in 1986. The II-nd study group was consisted from the 45 children born in 1983 - 1985 resident in town Pripyat with thyroid exposure doses from 65 to 616 sZv and total irradiation doses from 0.2 to 13.2 sZv.

The 25 children born in 1983 - 1988 and resident in radiation situation - favourable region of Ukraine constituted the Control (III-rd) group.

The cytogenetic study was held after the complex clinical examination and medical-genetic consulting of children both with their families. That enabled to exclude the factors suspected to effect the cytogenetic study results (prophylactic vaccinations, viral and bacterial infections, reparation diseases in family etc.).

For the lymphocytes metaphasal chromosomes preparations the 0.5 ml of heparinized venous blood was added to 4.5 ml of RPMI-1640 cultural medium (containing 15% fetal calf serum, 2.5% of FGA, 1% of L-glutamine and antibiotics). Incubation was carried out for 48 - 50 hours under 37 degrees santigrade in plastic vials. The preparations were received with standard method. The heated up to 37 degrees 0.075 M KCl solution was applied for hyposmolarity, the methyl alcohol and glacial acetic acid in 3 : 1 ratio were used for fixation. The preparations were placed in trypsin before dying (50 mg : 100 mL of distilled water) for 47 seconds. The Gimza dye was applied. The coded preparations were microscoped with oil immersion under the x900 magnification. The 100 - 400 metaphases containing 46 ± 1 chromosome were analysed in every person. The Yunis method [3] was applied for differentially dyed earlymitosed chromosomes obtaining.

The following types of chromosomal aberrations were taken into account: dicentric and ring chromosomes, single and double fragments. The analysis results were fixed in the standard registry protocol. The dicentrics and rings were taken into account for the exchange aberrations frequency calculation. The free fragments not relevant to the exchange type aberrations - for the fragments frequency calculation respectively.

The data concerning irradiation doses values, clinical and cytogenetic studies results were fixed in the Data base and processed with Excel software on PC.

RESULTS AND DISCUSSION

According to the received results the aberrant cells and chromosomal aberrations are present with the same frequency ($1.45 + 0.22\%$) among the Control group.

The chromosomal type aberrations were presented mainly with double fragments ($0.90 \pm 0.1\%$) and dicentrics ($0.01 + 0.01\%$). The chromatide type aberrations number consisted $0.55 \pm 0.90\%$.

Thus the somatic cells mutations level among children of Control group is not different from data of other researchers [4, 5].

In children born from the CACCP - ARS survivors the aberrant cells and chromosomal aberrations were revealed with frequency of $2.38 \pm 0.23\%$ and $2.40 \pm 0.24\%$ respectively, that exceeded the control value ($p < 0.001$). The chromosomal type aberrations value (double fragments, dicentrics, ring chromosomes) consisted $1.00 \pm 0.19\%$ and not exceeded the control one. The chromatide aberrations frequency was $1.40 \pm 0.20\%$ that is confidentially higher ($p < 0.01$) than in Control group (table).

Table - Chromosome aberrations frequency in Study groups

Parameters	Study groups		
	Born from CACCP-ARS survivors	Evacuated children	Control group
Number of children	15	45	25
Cells with chromosome aberrations (%)	$2,38 \pm 0,23^*$	$2,70 \pm 0,28^*$	$1,45 \pm 0,22$
Cromosomal aberrations (%)	$2,40 \pm 0,24^*$	$2,70 \pm 0,28^*$	$1,45 \pm 0,22$
Dicentrics & rings (%)	$0,08 \pm 0,03$	$0,23 \pm 0,03^*$	$0,01 \pm 0,01$
Double fragments (%)	$0,92 \pm 0,19$	$1,00 \pm 0,12$	$0,90 \pm 0,10$
Single fragments (%)	$1,30 \pm 0,18^*$	$1,22 \pm 0,17^*$	$0,55 \pm 0,90$

* - confidential difference from control ($p < 0.01$)

Consequently the aberrant cells and chromosomal aberrations were confidentially more frequent in children born from CACCP - ARS survivors compared to that in control. The chromatide type aberrations presented the significant quota of all the chromosomal aberrations.

The aberrant cells and chromosomal aberrations number was equal (consisting $2.70 \pm 0.28\%$) in children exposed to ionising radiation effect in town Pripjat during infant and early age. That value exceeded the control one ($p < 0.001$). The unstable chromosomal aberrations of exchange type (dicentric and rings) were revealed with frequency of $0.23 \pm 0.03\%$ and were over the control levels ($p < 0.001$). The double fragments number consisted $1.00 \pm 0.12\%$ here, and $0.90 \pm 0.10\%$ in control ($p > 0.05$).

So the children evacuated from town Pripjat have the cytogenetic status distinct peculiarities characterised with aberrant cells and chromosome aberrations (both chromosomal - dicentric and rings, and chromatide - single fragments) frequency increase compared to control.

For possible interrelation revelation between total irradiation dose and cytogenetic study data the correlational analysis was applicated. The confidential correlational relationships presence were fixed between the aberrant cells total number, chromosomal type aberrations (double fragments, dicentric) frequency and total irradiation dose. The correlation parameters value consisted 0.48 - 0.54 (figure).

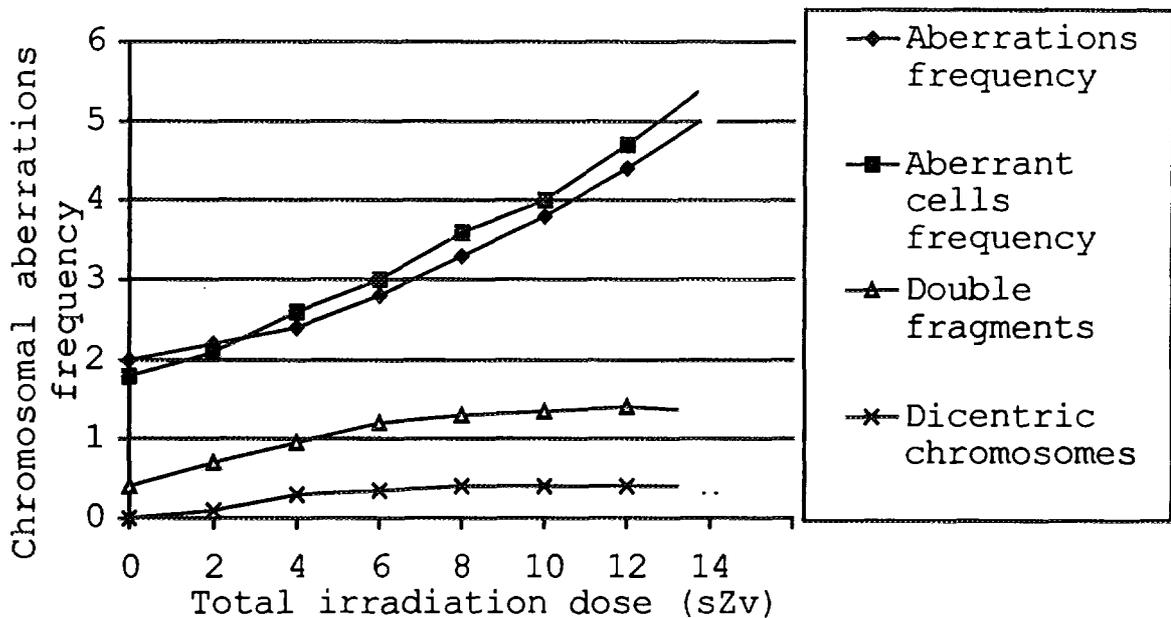


Fig. - Chromosome aberrations frequency distribution depending on total irradiation dose

Therefore radiation effect cytogenetic markers are revealed during the remote post - accidental period in children exposed to ionising radiation total exposure doses range 0.20 - 13.2 sZv. That may indicate the damage on the stem cells - precursors level and mutant cells clones initiation.

We consider the aberrant cells number and chromosome aberrations increase both with that of chromosomal type (dicentric and rings) and chromatide type (single fragments) in children born from Chernobyl accident consequences cleaning up participants - acute radiation syndrome survivors and in children evacuated from town Pripjat, indicate the chromosome apparatus instability. That may occur the risk factor for stochastic effects during the postaccidental period remote terms.

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