Federal Medical-Biological Agency (Russia)
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Chronic Radiation Syndrome (CRS) in residents of the Techa riverside villages

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Techa river (dynamics of liquid radioactive wastes releases into the Techa river)

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Number of CRS cases in dynamics

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Diagnosis verification

**Measures**

- Dynamic follow up of the patients health status
- Assessment of the concomitant pathology in the CRS formation period
- Reconstruction of the individual organ doses

**Results**

- First verification of 1 159 CRS cases was performed in 1959-1964. **Conclusion:** Residents of the Iset river basin were diagnosed with CRS without reasonable ground
- Second verification of 940 cases was performed in 1980-1984. **Conclusion:** CRS diagnosis in 66 patients raised no doubts

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Dynamics of dose rate, cumulative dose formation (TRDS-2009) and its distribution at the period of CRS diagnosis

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The periods of CRS clinical course

• Latent period (typically lasts for 1-5 years)
• CRS formation period. It coincided in time with the exposure at the highest dose rate. Alteration processes prevailed
• Recovery period. It usually started 3-12 months after the termination of exposure, or following a considerable decrease in dose rate. During this period repair processes start to prevail over alteration
• The period of late effects
CRS clinical picture in the formation period

- Non-specificity of CRS symptoms
- Multiple organ clinical manifestations (inhibition of hematopoiesis and immunity; neurologic disorders; impairments of cardiovascular, digestive, endocrine and other systems)
- Changes of hematopoiesis and nervous system occupy leading positions in the CRS clinical picture
- Dynamics of syndrome formation and recovery of post-radiation changes is determined by organ doses (to a great extent by dose rate):
  - Under protracted exposure at doses exceeding the threshold for tissue reactions development in critical systems the syndrome was characterized by progressive course
  - Exposure termination or significant decrease in dose rate leads to recovery of hematopoiesis, neurologic disorders and other visceral changes
Major CRS symptoms

Changes of hematopoiesis

• *In the peripheral blood*: leukopenia, neutropenia with left-shift in leukogram, thrombocytopenia, rarely – lymphocytopenia

• *In the BM*: delay in the BM granulocyte maturation at the stage of myelocyte, decrease in the activity of megakaryocytes, increase of proliferative activity, and accelerated maturation of erythrokaryocytes, increased level of aberrant neutrophilic and erythroid cells at the stage of mitosis or at interphase

Neurological disorders

• Vegetative dysfunction (arterial hypotonia, bradycardia, disturbed motor and secretory functions of the digestive organs, etc.)

• Asthenic syndrome (significant weakness, increased fatigability, sleep disorders, etc.)

• Microorganic disorders of the nervous system (persistent nystagmus, static or dynamic ataxia, muscular hypotonia, anisoreflexia of the tendon and periosteal reflexes, pathological reflexes, etc.)

Ostealgic syndrome

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Degrees of CRS severity

- **Mild degree**: unstable moderate leukopenia, less frequently – thrombocytopenia, absence of BM hypoplasia, syndrome of vegetative dysfunction (arterial blood pressure instability, impairment of stomach secretory function and motor activity of GIT, etc.) and initial signs of asthenia (general feeling of weakness, fatigue, sleep disorders, etc.)

- **Moderate degree**: resistant marked leukopenia, neutropenia, lymphocytopenia, and thrombocytopenia, BM hypoplasia, marked asthenia, initial signs of organic disorders of the nervous system, myocardial dystrophy, stable achylia, arterial hypotension, menstrual disorders, etc.
Recovery period

Dynamics of mean neutrophil count in the peripheral blood of CRS patients in 1951-2001

- By 1956-1960s cellular composition of the peripheral blood and bone marrow hematopoiesis returned to normal state, and functional impairment of the central nervous system typically disappeared.
- Ostealgic syndrome and microorganic disorders of the CNS persisted till 1961-1965 and later.

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CRS late effects

Morbidity structure

Mortality structure

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Conclusion

• CRS represents a systemic response of the body as a whole to the chronic total body exposure in man

• At the initial stage, CRS can be defined as a “disregulatory” pathology which is formed on the basis of radiation-induced disorders in the regulatory systems of man (nervous, endocrine and immuno-hematopoietic). The changes in the cardio-vascular, digestive, reproductive, and other systems, are of a secondary functional nature, and are reversible

• Higher doses to regulatory and visceral organs induce irreversible organic alterations (vascular disorders, dystrophy, fibrosis, BM hypoplasia, etc.), and the course of CRS may assume an irreversible character
Conclusion

• The actual number of CRS cases diagnosed among members of the Techa riverside communities was much lower than that diagnosed in the initial period (940 cases)

• Taking into account the predominantly functional character of the CRS symptoms demonstrated by the residents of the villages on the Techa, and a selective approach to conducting medical examinations of the population during the period of CRS formation, it is deemed unfeasible to re-assess the exact number of CRS cases

• In humans, hematopoiesis manifests a sufficiently higher tolerance to chronic radiation exposure. No cases of expressed BM hypoplasia were noted among residents of the riverside villages
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