

第 108 回日本精神神経学会学術総会

シンポジウム

## Mental Disorders in Persons Exposed to Radiation after Chernobyl Nuclear Power Plant Accident

Mykhaylov Volodymyr<sup>1)2)</sup>, Zdesenko Irina<sup>3)</sup>

1) Kharkov National Medical University, Kharkov, Ukraine,

2) Kharkov Regional Clinical Psychiatric Hospital № 3 (Kharkov, Ukraine),

3) State institution “Institute of Neurology, Psychiatry and Narcology NAMS of Ukraine” (Kharkov, Ukraine)

The purpose of our research was to study mental disorders in persons exposed to radiation after the Chernobyl nuclear power plant (NPP) accident.

Three-hundred patients exposed to low doses of radiation after the Chernobyl NPP accident were enrolled. All of them were males aged 30–45 years old. Their external exposure dose was less than 100 Rem (1 grey). Patients were examined with clinical psychopathological, instrumental, and biochemical methods. A survey of patients was held in 4 stages : 1st stage from 1986–1989, 2nd stage from 1990–1993, 3rd stage from 1994–1999, and 4th stage from 2000 till the present.

The following main polymorphic clinical forms of psychic disorder in our patients were determined at the different research stages : asthenic, neurasthenic, hypochondriac, subdepressive, obsessive, hysteria, paroxysmal, and psychoorganic.

Four levels of pathogenesis mechanism were estimated by data analysis. They are substance-morphological, substance-functional, brain regulatory-system disorganized, and psychogenic-personality. Somatoform, affective, and psycho-vegetative disturbances as well as organic mental syndrome were resistant to traditional medical therapy. New methods of complex therapy and rehabilitation/prevention measures in patients with nonpsychotic disorders that suffered from the Chernobyl disaster were developed. A rehabilitation program, which included in-patient, out-patient, family, and recreative-resorts steps was used. Comparison with the control group showed the high efficacy of the rehabilitation program in 80% of patients.

<Key words : mental disorders, psychoneurological disorders, nonpsychic psychic disorders, nuclear power plant>

The twenty sixth of April 2012 was the twenty-sixth anniversary of the Chernobyl nuclear power plant (NPP) accident, which became the worst disaster in the history of nuclear engineering. The global community has never lost its focus on the disaster. For those 26 years, a wealth of data have been gathered, and

it is now possible to estimate the medical consequences of the accident<sup>1~3)</sup>.

It is a common practice to assess the medical consequences by the external radiation dose. The Chernobyl accident tasked medical science with the problem of human exposure with small doses of ionizing radiation and its conse-



Fig. 1 Persons who were involved in disaster clean up

quences<sup>2)</sup>. For a majority of people who were involved in the Chernobyl accident events, the maximum total exposure was 25 Rem (0.25 Sivert)<sup>1)</sup> (Figure 1).

The major dose-forming radionuclides which caused radio-contamination were iodine-131, a gamma and beta-emitter with a 7.7- day half-life ; strontium- 90, a beta- emitter with a 17.5 year half-life period ; cesium- 137, a gamma and beta emitter with a half-life of 70 to 140 days (Table 1).

At the same time, the exposure was multi-factorial and accompanied by multiple non-radiation factors. The victims were exposed to graphite, asphalt, bitumen and polymeric materials from combustion and melting products, lead fumes, etc.<sup>3)</sup>.

The levels of emergency workers performance were also impacted by the level of economic development in the community, “misinformation”, gaps in social support, shortcomings of medical care, the family status, character of inter-spousal relations, and household status<sup>3)</sup>.

The interaction between radiation and non-radiation factors facilitated synergism.

The main categories of the victims were :

1) over 5,000 people who lost employment due to involvement in disaster clean up, including those who suffered from acute radiation disease (145 patients) and chronic radiation disease

Table 1 Radiation and non-radiation factors in persons after Chernobyl NPP accident

Radiation factors (The major dose-forming radionuclides)		
iodine-131	strontium-90	cesium-137
Non-radiation factors		
Combustion and melting products of :	Macro-and micro social factors :	
graphite	level of economic development	
asphalt	“misinformation”	
bitumen	gaps in social support	
polymeric materials	medical care	
	household status	
	Inter-spousal relations	

(1,500 people) ; over 15 thousand people whose poor health was a consequence of the Chernobyl disaster :

2) over 200 thousand citizens who took part in the disaster clean up ; over 130 thousand people relocated from polluted areas ;

3) 60 thousand children whose thyroid gland exposure exceeds the limit ; 1 mln. people who live in the radionuclide-polluted areas ;

4) 1.5 mln. people who live or reside in areas requiring high-level radiological control.

The morbidity structure of radiation-exposed people is as follows : 1) cardiovascular diseases : hypertensive disease, ischemic heart disease, cerebrovascular pathology, vegetative-vascular asthenia ; 2) nervous and psychic disorders ; 3) malignant tumors ; 4) affection of respiratory, digestive and urinary systems<sup>1)</sup>.

The leading cause of death is ischemic heart disease, second place is malignant tumors, and third place is a cerebrovascular pathology.

However, since the first days after the accident, psycho-neurological disorders have been prevalent in persons exposed to radiation. After

Table 2 Stages of development of neuropsychic disorders in persons after Chernobyl NPP accident

1st stage	2nd stage	3rd stage (second activation)	4th stage
Main categories of patients : VVA patients 53% ; chronic cerebral ischemia patients 41% ; acute cerebral circulation disorders patients 6%	“break” in pathological process	Main categories of patients : VVA patients 62% ; hypertension 27% ; cerebral atherosclerosis 5% ; acute cerebral circulation disorders patients 6%	Main categories of patients : hypertension patients 47% cerebral atherosclerosis patients 23% cerebral strokes patients 12% encephalopathy patients 69%
Clinical syndromes : asthenic 86% neurasthenic syndromes 14% liquor hypertension 37.6% vestibular syndrome 16.8% paroxysmal syndrome 54%	further changes in immunological parameters	Clinical syndromes : asthenic 30% neurasthenic 64% hypochondriac 18.1% subdepressive 17.9% obsessive 6.9% hysteroform 17.1% liquorhypertention 92% vestibular 25% paroxysmal 58% psychoorganic 38%	Increase “psyhoorganic” process ; Decrease neurotic disorders
Microcirculatory disorders (bulbar conjunctiva vascular changes, retinal vessels)	Micro-circulatory disorders		
Neuropsychological disorders of attention, memory, thinking process	Neuro-psycho-logical disorders	Disorders of attention, memory, emotional-volitional disorders	Disorders of attention, memory, emotional-volitional disorders

more than 26 years, there is no definitive explanation for this.

Thus, the aim of our research was to study the clinical structure and dynamics of nonpsychic psychic disorders within psychic-neurological disorders in those exposed to radiation.

For conducting research, we examined 300 male workers involved in disaster clean up whose age in 1986 was between 30 and 45 years old. Their external exposure dose was less than 100 Rem (1 grey).

Patients were examined with clinical psychopathological, instrumental, and biochemical methods. A survey of patients was held in 4 stages : 1st stage from 1986–1989 ; 2nd stage from 1990–1993 ; 3rd stage from 1994–1999 ; 4th stage from 2000 till present.

The results showed that, in the first stage, three groups of patients could be identified : vegetative-vascular asthenia (VVA) patients

(VVA- term developed in the USSR and corresponded to category “Other disorders of autonomic nervous system” G 90.8 (ICD-10)) –53% ; chronic cerebral ischemia patients (I 67.8, G 93.4 (ICD-10)) –41% ; acute cerebral circulation disorders patients (G 45, G 46, I 60- I 67 (ICD-10)) –6% (Table 2).

The following clinical syndromes were diagnosed : asthenic (86%) and neurasthenic syndrome (14%), liquor hypertension (37.6%), vestibular syndrome (16.8%), and paroxysmal syndrome (54%).

Further observations between 1990 and 1993 showed relative stabilization ; a kind of “break” in the pathological process with its subsequent activation in 1994.

The underlying disease was asthenic syndrome which shifted from its physiogenic to psychogenic form and acquired traits of hypochondria (18.1%), subdepression (17.9%), obsession

(6.9%), and hysteria (17.1%).

Thirty-eight percent of patients were diagnosed with cognitive deficiency syndrome. This syndrome could be expressed in three variants : -dementive-with intellectual and mnestic impairment ; affective-instability-with emotional-volitional sphere disorders ; character-pathic-with prevailing personality disorders amid intellectual and a mnestic impairments.

There were identified with hypertension disease (27%) and cerebral atherosclerosis (5%). Also demyelinated-type spinal circulation disorders were identified.

At the fourth stage we have detected a common tendency toward increased "organic" processes with decreased neurotic disorders. There are more hypertension patients (47%), cerebral atherosclerosis patients (23%), and cerebral strokes patients (12%). Encephalopathy (term was developed in the USSR) with its neurologic and psychic deficits and specific morpho-functional cerebral changes developed in 69% of patients.

Analysis of the data obtained made it possible to single out pathogenetic levels of pathological changes.

I. Structural and morphological-disorders in lipid and collagen metabolism which lead to changes in elastic properties of vessel walls.

II. System and functional-impaired functions of integrative cerebral systems of the brain (mostly of the diencephalic level) which regulate vascular tone, vegetative and emotional reactions, and other basic functions.

III. Organism level-manifestation of clinical symptoms at the level of the organism (encephalopathy, hypertension, and cerebral atherosclero-

sis).

IV. Psychogenic-personal- an individual's response to his or her disease and changes in a set of social conditions.

We referred to the multi-level system of pathological processes we developed and applied a system of medical and preventive interventions aimed at stabilizing and further developing preventive measures for the prevention of psychoneurological disorders in persons exposed to radiation. The main principles of this system are its complex nature, stage-by-stage approach, and consistency. This system has been promoted with in-patient, out-patient, family, and recreative-resorts parts. It includes medication, psychotherapy, and social therapy with the development of mindsets of personal responsibility for one's health. We conducted group psychotherapy with individual personality-reconstructive therapy which included suggestive, cognitive-behavioral therapy. Comparison with the control group showed high efficacy of the rehabilitation program in 80% of patients.

#### References

- 1) Ivanov, V. K., Gorski, A. I., Maksioutov, M. M., et al.: Mortality among the Chernobyl emergency workers : estimation of radiation risks (preliminary analysis). *Health Phys*, 81 (5) ; 514-521, 2001
- 2) McGale, P., Darby, S. C.: Low doses of ionizing radiation and circulatory diseases : a systematic review of the published epidemiological evidence. *Radiat Res*, 163 ; 247-257, 2005
- 3) Zdesenko, I.: The influence of micro-and macro-social factors on the psychic state in patients affected by Chernobyl disaster. *Archive of Psychiatry*, 10 (37) ; 23-26, 2004