

УДК 614.876-071

¹ B. Grosche, ² L.M. Pivina, ³ K.N. Apsalikov, ⁴ B.I. Gusev, ⁵ T.I. Belichina¹ Federal Office for Radiation Protection, Germany,² State Medical University, Semey,^{3,4,5} Institute for radiation Medicine and Ecology, Semey

COHORT STUDY OF HEALTH EFFECTS IN THE RESIDENTS EXPOSED TO IONIZING RADIATION – PROSPECTIVE

Since World War II more than 2,000 nuclear explosion tests have been conducted around the world of which the former Soviet Union conducted more than 700. The Soviet nuclear tests began in the Semipalatinsk Test Site (STS) in current Kazakhstan. The test site covers an area of 18,500 km² and is named after the city of Semipalatinsk, which is located approximately 150 km east of the test site. A total of 456 nuclear tests were conducted at the site during 40 years from 1949 to 1989. During 1949 to 1962 a total of 118 nuclear tests were conducted above ground and in the atmosphere, while 338 tests during 1961 to 1989 were conducted underground in boreholes and tunnels (Lukashenko SN (ed.), 2011). It is considered that 13 of the underground tests caused a radioactive release to the atmosphere. These releases, along with releases from the testing in 1949-1962, caused radioactive plumes that affected people and territories adjacent to the site, in particular the former Semipalatinsk oblast (region) (REA, 2010).

The health effects of exposures to fallout from Soviet nuclear weapons testing for the residents living near by the Semipalatinsk nuclear test site in Kazakhstan have not yet been investigated to their full extent. The historical cohort was originally set up by the local research institution "Dispensary No. 4" which was later succeeded by the Research Institute for Radiation Medicine and Ecology, Kazakhstan. The historical cohort included residents from ten highly exposed and six control settlements, for comparison. The cohort's exposed group contains 9,850 permanent residents of the exposed settlements, all born before 1 June 1961. The comparison group includes 9,604 inhabitants, also born before 1 June 1961 and frequency-matched to the exposed group by age and gender. This cohort was finalized and

quality assurance measures were taken within an EC funded INCO-COPERNICUS project.

The total radiation doses consisted of external and internal doses. The external dose was calculated considering exposure due to the radioactive cloud and fallout deposition. Dose estimations were based on the distance from the epicenter, exposure rates, yield, altitude of detonation above ground, and wind velocity during and after the nuclear tests (B. I. Gusev). The internal dose was estimated for radioiodine isotopes, ¹³⁷Cs and ⁹⁰Sr, which had been measured in soil samples of 1963. Cumulative average equivalent dose estimates were derived by summation of average equivalent dose estimates from several consecutive nuclear test exposures for that settlement (K. N. Apsalikov). Four of the atmospheric tests conducted between 29 August 1949 and 24 August 1956 accounted for more than 95% of the estimated cumulative dose, 90% of which was accumulated within the first year of exposure (K. Gordeev).

The most recent analysis was published in 2011 where the relationship between mortality from cardiovascular diseases and radiation exposure from the fall-out was assessed (Grosche B. *et al*, 2011). The dosimetric approach for this study was developed by the US National Cancer Institute and the whole body external dose for the cohort members ranged from 0 to 0.63 Gy. The study concluded that there was no detectable risk of radiation related mortality from cardiovascular diseases in this cohort. Nonetheless, there was weak evidence that the point estimate for the radiation related risk might increase with increasing time since exposure. It is necessary to perform the prospective follow-up for various long term health effects from chronic exposure to low and moderate doses.

УДК 616.127-616.27-084

J. Slezak, N. Tribulova, M. Ivanova, J. Styk, K. Frimmel, T. Ravingerova, M. Fulop*, L. Okruhlicova

Institute for Heart Research, Slovak Academy of Sciences and Slovak Medical University*
Bratislava, Slovak Republic

CHRONIC MYOCARDIAL ISCHEMIA AS AN UNDESIRABLE SIDE EFFECT OF MEDIASTINAL IRRADIATION INJURY MOLECULAR PATHWAYS AND POSSIBILITIES OF PREVENTION

Chronic ischemic injury of the myocardium is increasingly recognized as an undesired side effect of radiation of cardiovascular system after mediastinal radiation therapy for malignancies.

The study concentrates on pathology of radiation-induced cardiovascular toxicity and on prevention of injury of healthy tissues in areas at risk. Irradiation of the heart with a single dose of 30 Gy delivered to the heart region was performed on male Wistar rats.

Adverse effect of ionizing radiation is mostly mediated by reactive oxygen and nitrogen species, which deplete antioxidant stores. Radiation damage of cardiovascular system shows that endothelial cells are the most radiation sensitive part of vasculature. Microvascular injury leads to myocardial ischemia.

Chronic myocardial underperfusion results in pathophysiological reaction connected with protective mechanism. Myocytes adjust its contraction function which is

characterized by down regulation in energy utilization, attenuated level of contractile function, upregulation of stress proteins, cardiomyocyte dedifferentiation and by myocyte remodeling. Morphologically, chronic hypoperfusion results in loss of myofilaments, increased amount of glycogen and small dark mitochondria, typical signs of *hibernating* myocardium.

Protection of normal tissue against radiation-induced damage may increase the therapeutic benefit of radiotherapy. Different more or less effective measures to prevent radiation-induced injury and to increase cardiovascular tolerance to irradiation of healthy tissue have been evaluated. Further investigation is needed to determine the most effective prevention of radiation injury to healthy tissues accidentally targeted by radiation.

УДК 616-089 (574) (520)

Shigeto Maeda, Naomi Hayashida, Shunichi Yamashita

Department of Surgery, National Nagasaki Medical Center

SURGICAL COLLABORATION WITH SEMIPALATINSK (KAZAKHSTAN) AND NAGASAKI (JAPAN) FOR 10 YEAR EXPERIENCE

Abstract:

Background: From 1949 to 1989, 456 nuclear tests were conducted by the former Soviet Union at the Semipalatinsk Nuclear Test Site (SNTS) in Kazakhstan. Exposure was primarily from the first test in August 1949, that affected the northern Semipalatinsk regions, a plutonium bomb in 1951, and a thermonuclear-bomb test in 1953, that affected the Semipalatinsk region southeast of the SNTS. A noticeable increase in the number of cases of Hashimoto's thyroiditis and thyroid cancer were reported. It is very important to assess the clinical behavior of thyroid cancer which may be affected by SNTS in the control of an accurate diagnosis and standardized surgery. We have collaborated with the Semipalatinsk Oncology Center since 1999, in order to establish an optimal method to diagnose and perform a thyroidectomy and a lymph node dissection for the patients with papillary thyroid cancer that is better suited for the Semipalatinsk environmental effects. Every year, SM visited Semipalatinsk Oncology Center from 1999 to 2009 to have some lectures and operations with local physicians and surgeons.

Objective: To assess the change of diagnostic accuracy and thyroid surgery from 1999 to 2009 in Semipalatinsk Oncology Center in collaboration with Nagasaki University and Nagasaki Medical Center.

Material: A total of 169 patients with thyroid cancer who underwent thyroid surgery at the Semipalatinsk Oncology Center were evaluated. From the 169 patients, 125 patients with papillary thyroid cancer were assessed for surgical procedure.

Method: This was a cross-sectional observational study.

Results:

1. Before 2001, there were few preoperatively diagnosed thyroid cancers and from 2002, preoperatively diagnosed papillary cancers increased.

2. From 1999 to 2001, there were no thyroid surgeries with cervical lymph node dissections. The partial lobectomies were mainly performed until 2001. From 2002, total lobectomies were chosen for the majority of the patients, but total thyroidectomies were rarely performed. The lymph node dissection was added occasionally, but rarely.

Conclusion: The optical method to diagnose thyroid tumor was performed, and an accurate diagnosis of thyroid cancer changed the surgical procedure during the period of this study. An accurate diagnosis and standardized surgery for thyroid cancer helped to evaluate the biological characteristics of thyroid cancer which may be affected by SNTS in next decade.

УДК 616-006-08

R.R. Letfullin¹, B.D. Murphy²

¹Rose-Hulman Institute of Technology, Terre Haute, Indiana, USA;

²Radiological Technologies University, South Bend, Indiana USA

NANOPARTICLE ENHANCED X-RAY THERAPY OF CANCER

Abstract. Nanomedicine is the use of nanoparticles in medical practice, and can refer both to classical procedures improved using nanoparticles or entirely new techniques developed to exploit certain nanoparticle behaviors in the body. Nanophotothermolysis and nanophotothermia are two new techniques which exploit the strong light absorption properties of nanoparticles to generate heat in a small localized region. Conjugating nanoparticles with various biomolecules allows for targeted delivery to specific

tissues or even specific cells, cancerous cells being of particular interest. Previous studies have investigated nanoparticles at visible and infrared wavelengths where surface plasmon resonance leads to unique absorption characteristics. However, issues such as poor penetration depth of the visible light through biological tissues limits the effectiveness of delivery by noninvasive means. In other words, various nanoparticles have been investigated as contrast agents for traditional X-ray procedures, utilizing the