Bulletin of Russian State Medical University 2017 vol.6 N3, pages 75-78

Methods of genetic toxicology in the assessment of genomic damage induced by electromagnetic ionizing radiation

Ryzhkin S., Margulis A., Kurinenko B.
Kazan Federal University, 420008, Kremlevskaya 18, Kazan, Russia

Abstract

Medical or occupational exposure of patients and healthcare personnel to ionizing radiation (IR) can be a cause of genetic disorders. In this article we discuss the efficiency of the following tests used to comprehensively assess the effects of ionizing radiation on the genetic apparatus of a cell: The Ames test, the micronucleus test and the FISH method. We provide examples of their use, outline their advantages and drawbacks, estimate the possibility of designing more advanced test systems and discuss requirements for their implementation.

Keywords

Ames test, FISH, Gamma rays, Genetic toxicology, Ionizing radiation, Micronucleus test, Test system, X-ray radiation

References

[1] Mortelmans K, Zeiger E. The Ames Salmonella microsome mutagenicity assay. Mutat Res. 2010 Nov 20; 455 (1-2): 29-60.

[2] Margulis AB, Ryzhkin SA, Slesareva AN, Belonogova NV, Ponomarev VYa, Ilinskaya ON. Genotoksicheskiye effekty oblucheniya na rentgeno-komp'yuternykh tomografakh. Vestnik Kazanskogo tekhnologicheskogo universiteta. 2014; 17 (14): 380-2. Russian.

[3] Ryzhkin SA, Margulis AB, Belonogova NV, Ilinskaya ON. Comparative study of the X-ray diagnostic procedures safety using bacterial test-systems. In: Badalyan H, editor. Proceedings of International workshop 'Ionizing and non-ionizing radiation influence on structure and biophysical properties of living cells'; 2015 Sep 25-27; Tsakhkadzor, Armenia. Armenian Journal of Physics. 2016; 9 (1).

[4] Adler ID. Cytogenetic tests in mammals. In: Venitt S, Parry JM, editors. Mutagenicity testing: Practical approach. Oxford: IRL Press; 1984. p. 275-306.

[5] Petrashova DA, Pozharskaya VV, Belisheva NK. Genotoksicheskiye effekty prirodnykh istochnikov ioniziruyushchey radiatsii v limfotsitakh perifericheskoy krovi i bukkal'nom epitelii gornykh rabochikh. In: VII s'yezd po radiatsionnym issledovaniyam (radiobiologiya, radioekologiya, radiatsionnaya bezopasnost'); 2014 Oct 21-24; Moscow, Russia. Moscow: Izd-vo RUDN; 2014. p. 84. Russian.

[6] Bonassi S, Kirsh-Volders M, Stromberg U, Vermuelen R, Tucker JD. Human population studies with cytigenetic biomarkers; review of literature and future prospectives. Environ Mol Mutagen. 2005 Mar-Apr; 45 (2-3): 258-70. DOI: 10.1002/em.20115.

[7] Stavitskiy RV, editor. Meditsinskaya rentgenologiya: Tekhnicheskiye aspekty, klinicheskiye materialy, radiatsionnaya bezopasnost'. Moscow: MNPI; 2003. 344 p. Russian.

[8] Burlakova EB. Effekt sverkhmalykh doz. Vestnik RAN. 1994; 64 (5): 425. Russian.

[9] Mothersill C, Seymour CB. Radiation-induced bystander effects -implications for cancer. Nat Rev Cancer. 2004 Feb; 4 (2): 158-64. DOI: 10.1038/nrc1277.

[10] Domina EA. Meditsinskiye rentgenologicheskiye issledovaniya i kantserogennyye effekty. Problemi radíatsíynoí meditsini ta radíobíologíí (Problems of radiation medicine and radiobiology). 2014; 19: 35-47. Ukrainian.

[11] Domina EA. The radiobiological aspects of screening mammography: A reminder about possible distant negative effects. In: Mezhdunarodnaya konferentsiya 'Radiobiologicheskie i radioekologicheskie aspekty Chernobyl'skoy katastrofy'; 2011 Apr 11-15; Slavutich, Ukrain. Slavutich: Fitosotsiotsentr; 2011. p. 28.

[12] Khvostunov IK, Shepel NN, Sevankayev AV, Nugis VYu, Korovchuk ON, Kursova LV et al. Sovershenstvovaniye metodov biologicheskoy dozimetrii putem analiza khromosomnykh abberatsiy v limfotsitakh krovi cheloveka pri obluchenii in vitro i in vivo. Mediko-biologicheskiye problemy zhiznedeyatel'nosti. 2013; 1 (9): 135-47. Russian.

[13] Snigiryova GP. [Biological dosimetry on the strength of cytogenetic analysis]. Vestnik Rossiyskogo nauchnogo tsentra rentgenoradiologii. 2011; (11) [Internet]. [cited 2017 Apr] Available from: Http://vestnik.rncrr.ru/vestnik/v11/papers/snigir2-v11.htm. Russian.

[14] Kolyubayeva SN. Ispol'zovaniye tsitogeneticheskikh metodov v radiatsionnoy meditsine. Vestnik Rossiyskoy Voyennomeditsinskoy Akademii. 2008; 3 (23 Suppl 1): 179. Russian.

[15] Mozerova EYa. [New sources of low doses of radiation: results of development of diagnostic and therapeutic radiology]. Radiation Hygiene. 2012; 5 (2): 71-4. Russian.

[16] Ryzhkin SA, Ivanov SI, Patyashina MA, Ismagilov RK, Akopova NA, Loginova SV et al. [Modern peculiarities of the medical exposure levels forming of the tatarstan republic population during x-ray procedures implementation]. Radiation Hygiene. 2015; 8 (1): 45-54. Russian.

[17] Ryzhkin SA, Sharafutdinov BM, Mikhaylov MK. [Experience with different single-stage selective arterial catheterization procedures during x-ray endovascular interventions to reduce a radiation dose for patients]. Vestnik rentgenologii i radiologii. 2017; 98 (1): 30-5. Russian.

[18] Valentin D, editor. Radiatsionnaya zaschita v meditsine. Saint- Peterburg: NII radiatsionnoy gigieny im. prof. P. V. Ramzaeva; 2011. 66 p. Available from: http://www.icrp.org/docs/P105Russian.pdf. Russian.

[19] Vasilyev SA, Stepanova EYu, Kutenkov OP, Belenko AA, Zharkova LP, Bolshakov MA et al. Dvunitevyye razryvy DNK v limfotsitakh cheloveka posle odnokrat-nogo vozdeystviya impul'sno-periodicheskogo rentgenovskogo izlucheniya v malykh dozakh: nelineynaya dozovaya zavisimost'. Radiatsionnaya biologiya. Radioekologiya. 2012; 52 (1): 31-8. Russian.