Title: Automatic detection of micronuclei by cell microscopic image processing

Authors: Mohammad Taghi Bahreyni Toossi, Hosein Azimian, Omid Sarrafzadeh, Shokoufeh Mohebbi, Shokouhozaman Soleymanifard

PII: S0027-5107(17)30004-0
DOI: http://dx.doi.org/doi:10.1016/j.mrfmmm.2017.07.012
Reference: MUT 11613

To appear in: *Mutation Research*

Received date: 14-1-2017
Revised date: 15-6-2017
Accepted date: 28-7-2017

Please cite this article as: Mohammad Taghi Bahreyni Toossi, Hosein Azimian, Omid Sarrafzadeh, Shokoufeh Mohebbi, Shokouhozaman Soleymanifard, Automatic detection of micronuclei by cell microscopic image processing, Mutation Research/Fundamental and Molecular Mechanisms of Mutagenesishttp://dx.doi.org/10.1016/j.mrfmmm.2017.07.012

Automatic detection of micronuclei by cell microscopic image processing

Mohammad Taghi Bahreyni Toossi[1], Hosein Azimian[1],Omid Sarrafzadeh*[2], Shokoufeh Mohebbi[3], Shokouhozaman Soleymanifard[1]

[1] Medical Physics Research Center, Mashhad University of Medical Sciences, Mashhad, Iran

[2] Department of Biomedical Engineering, Mashhad Branch, Islamic Azad University, Mashhad, Iran

[3] Medical Physics Department, Reza Radiation Oncology Center, Mashhad, Iran

Corresponding author: Omid Sarrafzadeh

Email: o.sarrafzade@gmail.com

Telephone: +98-513-662-9467

Cell phone: +98-915-521-2963

Abstract

With the development and applications of ionizing radiation in medicine, the radiation effects on human health get more and more attention. Ionizing radiation can lead to various forms of cytogenetic damage, including increased frequencies of micronuclei (MNi) and chromosome abnormalities. The cytokinesis block micronucleus (CBMN) assay is widely used method for measuring MNi to determine chromosome mutations or genome instability in cultured human lymphocytes. The visual scoring of MNi is time-consuming and scorer fatigue can lead to inconsistency. In this work, we designed software for the scoring of in vitro CBMN assay for biomonitoring on Giemsa-stained slides that overcome many previous limitations. Automatic scoring proceeds in four stages as follows. First, overall segmentation of nuclei is done. Then, binucleated (BN) cells are detected. Next, the entire cell is estimated for each BN as it is assumed that there is no detectable cytoplasm. Finally, MNi are detected within each BN cell. The designed Software is even able to detect BN cells with vague cytoplasm and MNi in peripheral blood smear. Our system is tested on a self-provided dataset and is achieved high sensitivities of about 98% and 82% in recognizing BN cells and MNi, respectively. Moreover, in