Different approaches towards the measurement of oxidative stress and its impact assessment in hematological and oncological perspectives

Ritam Chatterjee
Cooch Behar Panchanan Barma University, India

Rise in the level of intracellular reactive oxygen species (ROS) has immense effect on the biological system. In one hand, ROS can promote the maintenance of normal physiological functions, the phenomenon called as redox biology, and on the other hand increased ROS can damage genetic materials as well as cellular macromolecules, the process referred to as oxidative stress. Oxidative stress has been regarded as the etiological factor for wide varieties of pathologies.

With regard to oncogenesis oxidative stress behaves like a "double-edged sword" since it can act either as tumor promoter or as tumor suppressor. Thus measurement of oxidative stress and analysis of associated signaling system is gaining importance day by day in understanding any disease pathophysiology. In this study, two ways of detecting redox imbalance has been discussed. Firstly, with regard to hematopoietic disruptive condition viz; aplastic anemia, measurement of oxidative stress has been reported to be detected by subjecting bone marrow to dihydroethidium (DHE) staining.

DHE in presence of ROS gets converted to ethidium bromide emitting red fluorescence that can be easily measured flowcytometrically. In case of aplastic anemia, increased level of ROS has been found to be associated with disruption of mitochondrial membrane potential, destruction of hematopoiesis supportive microenvironment, increased adipogenesis, down-regulation of Notch-1 signaling, alteration of global DNA methylation pattern which all together leads to mitotic disruption and apoptosis in the hematopoietic compartment. Secondly, in the case of paraffinized tissue section, direct measurement of ROS is not possible due to its short half-life. Here, the oxidative stress can be measured by analyzing the effect of ROS on cellular molecules viz; peroxidation of lipid, DNA oxidation etc.

In case of oral pre-cancerous lesion - oral submucous fibrosis (OSF) and the cancerous condition - oral squamous cell carcinoma (OSCC), detection of oxidative stress has been reported to be done by measuring the level of 4 Hydroxynonenal (4-HNE) with immunohistochemistry. Being a product of lipid peroxidation, 4-HNE is a sensitive biomarker of oxidative stress. Validation of the same has been done with FTIR Spectroscopic analysis. During the malignant transformation of oral pre-cancers, oxidative stress is found to be associated with the generation of hypoxia, mitochondrial disruption, ERK linked progression of epithelial-mesenchymal transition (EMT) and acquisition of cancer stem cell phenotypes. Here, the suppression of the tumorsuppressive effect of the oxidative stress has been found to be associated with the SHH/Gli-1 linked up-regulation of survivin. Thus, from the above discussion, two different ways of detection of oxidative stress and associated alteration of signaling cascades evolved for freshly collected cellular sample as well as for fixed tissue sections.

Biography

Ritam Chatterjee is an assistant professor in department of zoology at Cooch Behar Panchanan Barma University, India. He was qualified for DBT research associate program in the year 2018. He was a PhD scholar in 2012.

ritschatt@gmail.com