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AWARENESS ABOUT THE ROS MEDIATED POST TRANSLATION MODIFICATION

Sasipriya G [1], Poonguzhali S [2], Sivakumar Ekambaram [3], Jagadeswaran [4] and Dhanraj Ganapathy [5]*

[1] Intern, Department of Prosthodontics, Saveetha Dental College and Hospitals, Saveetha Institute of Medical and Technical Sciences, Chennai, India.
[2] Student of Allied Health Science, First year, Department of Allied Health Science, Saveetha College of Allied Health Science, Saveetha Institute of Medical and Science Technology, Chennai, India.
[3] Assistant Professor & RSO, Department of Radiotherapy, Saveetha College of Allied Health Sciences, Saveetha Institute of Medical and Technical Sciences, Chennai, India.
[4] Principal & Professor, Saveetha College of Allied Health Sciences, Saveetha Institute of Medical and Technical Sciences, Chennai, India.
[5] Professor & Head of Department, Department of Prosthodontics, Saveetha Dental College and Hospitals, Saveetha Institute of Medical and Technical Sciences, Chennai, India.
*Corresponding Author Email:dhanraj@saveetha.com

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Abstract

Introduction: The toxicity associated with accumulation of reactive oxygen species (ROS) has led to the evolution of various defense strategies to overcome oxidative stress, including autophagy. This pathway is involved in the removal and degradation of damaged mitochondria and oxidized proteins. At low levels, however, ROS act as signal transducers in various intracellular pathways. **Aim:** This survey was conducted for assessing Awareness about the ROS mediated post translation modification among allied health science students. **Materials and Method:** Cross-section research was conducted with a self-administered questionnaire containing ten questions distributed amongst 100 Allied Health Science students. The questionnaire assessed about the ROS mediated post translation modification among Allied Health Science Students. The responses were recorded and analyzed. **Results:** 98% of the respondents are aware of the Reactive oxygen species. 92% of the students are aware of the ROS mediated post translational modification. 89 % of the students are aware of the mechanism of ROS mediated post translational modification. 32% of the respondents are aware that ROS mediated post translational modification removed damaged mitochondria. 47.5% of the students are aware that ROS acts as a signal transduction pathway. **Conclusion:** There is a limited awareness amongst Allied Health Science students about ROS mediated post translational modification. Enhanced awareness initiatives and educational programmes together with increased importance for curriculum improvements that further promote knowledge and awareness of ROS mediated post translational modification among Allied Health Science Students.

Keywords: Cysteine Oxidative Post-Translational Modifications; Oxidative Stress; Phytohormone Signaling; Reactive Oxygen Species; Redox Regulation; Signal Perception.

INTRODUCTION

The toxicity associated with accumulation of reactive oxygen species (ROS) has led to the evolution of various defense strategies to overcome oxidative stress, including autophagy. This pathway is involved in the removal and degradation of damaged mitochondria and oxidized proteins. At low levels, however, ROS act as signal transducers in various intracellular pathways.[1]

In plants, fluctuation of the redox balance by altered levels of reactive oxygen species (ROS) can affect many aspects of cellular physiology. ROS homeostasis is governed by a diversified set of antioxidant systems.

Perturbation of this homeostasis leads to transient or permanent changes in the redox status and is exploited by plants in different stress signaling mechanisms. [2]

These oxidative post-translational modifications (Ox-PTMs) lead to oxidative damage and/or trigger structural alterations in these target proteins. Characterization of the effect of individual Ox-PTMs on individual proteins is the key to a better understanding of how cells interpret the oxidative signals that arise from developmental cues and stress conditions.

The Cy's side chain, with its high nucleophilic capacity, appears to be the principal target of ROS. Ox-PTMs on Cy's residues participate in various signaling cascades initiated by plant stress hormones. [3]

ROS and RNS are free radicals, which can be defined as atoms or molecules containing one or more unpaired electrons in a valence shell or outer orbit that are capable of independent existence. The main cellular source of ROS and RNS is the mitochondrial respiratory chain.

ROS and RNS are also produced in the endoplasmic reticulum, peroxisomes, and phagocytic cells with the participation of xanthine and endothelial oxidase, as well as during the autoxidation of small molecules. They are also derived from exogenous sources, such as pollution, alcohol, industrial solvents, pesticides, drugs, etc. These sources are considered to be major factors that increase susceptibility to various diseases and accelerate aging.[4]

To maintain redox homeostasis, cells produce metabolites such as glutathione (GSH/GSSG) and nicotinamide adenine dinucleotide (phosphate) (NAD(H)/NADP(H)). So far, the most commonly investigated mechanism of redox regulation is mediation via the post-translational modifications (PTMs) of multiple proteins. Glutathionylation and S-nitrosylation of glyceraldehyde-3-phosphate dehydrogenase (GAPDH) influence the enzyme’s involvement in processes such as glycolysis, gene expression, and apoptosis.

All enzymes and several regulatory proteins of the Calvin–Benson cycle are also susceptible to redox-mediated PTMs, which influence carbon assimilation by photosynthetic organisms. Several reports have revealed that proteases can also be modified by nitrosation, selfenylation, sulfinylation, glutathionylation, and sulfonation.[5] This survey was conducted for assessing Awareness about the ROS mediated post translation modification among allied health science students.

MATERIALS AND METHODS

This cross-sectional research was conducted with a self-administered questionnaire containing ten questions distributed amongst 100 Allied Health science students. The students were randomly selected across various disciplines of Allied Health Sciences. The study setting was designated in the university campus. The survey instrument was a questionnaire pre tested and evaluated for validity and reliability concerns.

The questionnaire included ten questions eliciting the demographic data through open ended responses and multiple-choice questions for the other responses. The study was approved by the Institutional Ethical Committee and informed consent was obtained from the participants. The questionnaire was posted on an online platform and the identity of the respondents were kept confidential.

The questionnaire assessed the Awareness about ROS mediated post translation among Allied Health Science Students. The responses were recorded and analyzed. There were no incomplete responses and no dropouts from the study. The final data obtained was organized, tabulated and subjected to statistical analysis.

The salient questions in the study

1) Are you aware of Reactive oxygen species (ROS)?
2) Are you aware of the ROS mediated post translational modification?
3) Are you aware of the mechanism of ROS mediated post translational modification?
4) This pathway removes damaged mitochondria.
5) ROS acts as a signal transduction pathway.

RESULTS

98% of the respondents are aware of the Reactive oxygen species(Figure 1). 92% of the students are aware of the ROS mediated post translational modification(Figure 2). 89 % of the students are aware of the mechanism of ROS mediated post translational modificationFigure 3). 32% of the respondents are aware that ROS mediated post translational modification removed damaged mitochondria.(Figure 4) 47.5% of the students are aware that ROS acts as a signal transduction pathway.(Figure 5)

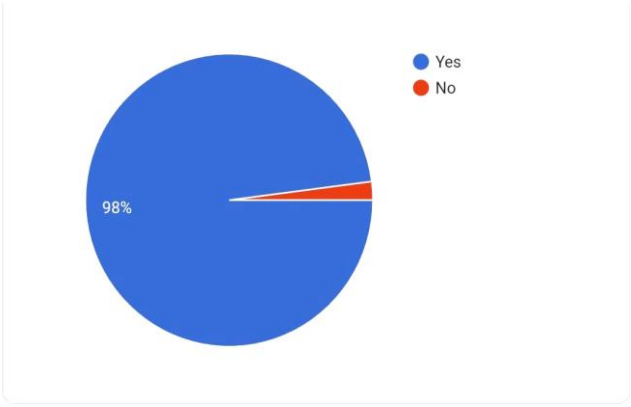

Fig 1: Awareness about Reactive oxygen species

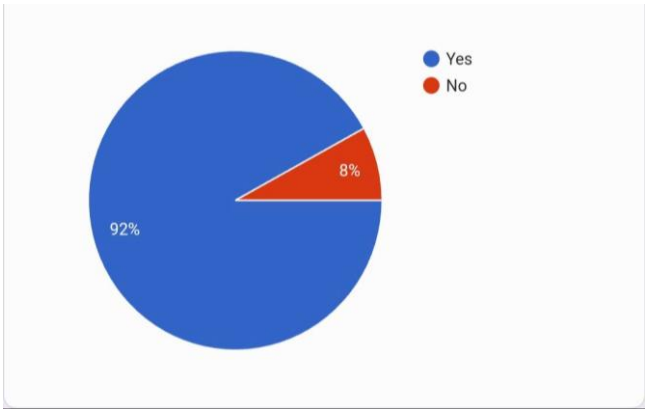

Fig 2: Awareness about ROS mediated post translational modification

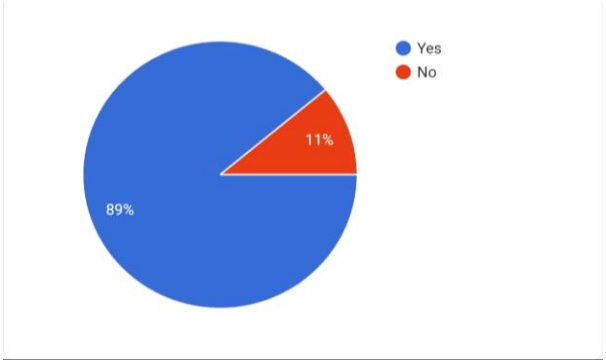

Fig 3: Awareness about mechanism of ROS mediated post translational modification

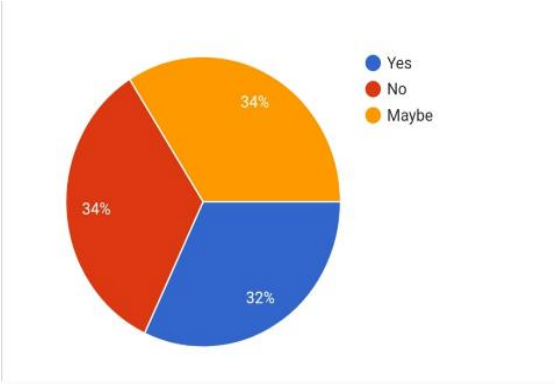

Fig 4: Awareness about ROS mediated post translational modification removed damaged mitochondria

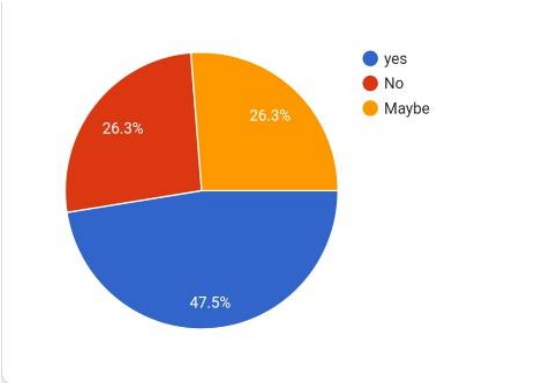

Fig 5: Awareness about ROS acts as a signal transduction pathway

DISCUSSION

The toxicity associated with accumulation of reactive oxygen species (ROS) has led to the evolution of various defense strategies to overcome oxidative stress, including autophagy. This pathway is involved in the removal and degradation of damaged mitochondria and oxidized proteins. At low levels, however, ROS act as signal transducers in various intracellular pathways. Homeostasis is the physiological ability to maintain physical and chemical conditions throughout the internal environment of the body within tolerable limits despite external perturbations. [6] 98% of the respondents are aware of the Reactive oxygen species

Homeostasis is based on processes such as temperature control, osmotic equilibrium, and anabolism/catabolism balance. Anabolic pathways require energy to generate complex molecules from simpler ones. The energy and molecules for anabolism are provided by catabolism, which refers to energy production via the breakdown of macromolecules. These include endogenic and exogenic proteins, lipids, carbohydrates, and nucleic acids. Macromolecule digestion is catalyzed by enzymes, which in turn are strictly regulated at different levels. These include synthesis as zymogens, compartmentalization, the requirements for specific amino acid sequences in a substrate, and the inhibition of and interaction with cofactors and signaling molecules [7]92% of the students are aware of the ROS mediated post translational modification

Signaling molecules are able to transmit information within and between cells. These molecules convey signals by binding to receptors and activating second messengers. Otherwise, they directly modify target molecules, such as enzymes. These signaling molecules are represented by proteins, amino acids, nucleotides, lipids, monoamines, polyisoprenoides, metal ions, gases, reactive oxygen species (ROS), reactive nitrogen species (RNS), etc[8]89 % of the students are aware of the mechanism of ROS mediated post translational modification

A striking example of proteins that transmit signals is kinases. Together with nucleotides, such as adenosine triphosphate (ATP) and guanosine triphosphate (GTP), kinases regulate vital pathways. Amino acids have been shown to inhibit autophagy in insulin-sensitive cells. Calcium ions are ubiquitous second messengers that regulate various processes in cells by binding to EF-hand-containing proteins. ROS are capable of modifying various signaling molecules and are involved in host defense processes and cell fate determination[9] 32% of the respondents are aware that ROS mediated post translational modification removed damaged mitochondria

ROS and RNS are known to cause homeostasis imbalance by inducing oxidative stress, which causes damage to lipids, proteins, and deoxyribonucleic acid (DNA). The accumulation of DNA damage leads to replicative senescence when cells are irreversibly arrested in the G1 phase of the cell cycle. Since the mitochondrial respiratory chain is the main intrinsic source of ROS, oxidative-dependent damage is considered to be the major reason for mitochondrial dysfunction. This, in turn, is associated with neuronal degeneration in age-related diseases . Protein oxidation disrupts the proteostasis network, which can decrease proteolysis and induce the formation of protein aggregates, such as amyloid fibrils and amorphous aggregates, related to neurodegenerative diseases and cataracts, respectively. On the other hand, oxidative stress is associated with accelerated rates of the proteolytic hydrolysis of myofibrillar proteins by μ-calpain, m-calpain, and caspase 3 during disuse muscle atrophy[10].47.5% of the students are aware that ROS acts as a signal transduction pathway

CONCLUSION

There is a limited awareness amongst Allied Health Science students about ROS mediated post translational modification. Enhanced awareness initiatives and educational programmes together with increased importance for curriculum improvements that further promote knowledge and awareness of ROS mediated post translational modification among Allied Health Science Students

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