IPD Project Details

Project ID: IPD3692

Project Title: A proteomics investigation of cigarette smoke exposed Wistar rats revealed improved anti-inflammatory effects of the cysteamine nanoemulsions delivered via inhalation

Description: Cigarette smoking is the major cause of chronic inflammatory diseases such as Chronic Obstructive Pulmonary Disease (COPD). It is paramount to develop pharmacological interventions and delivery strategies against the cigarette smoke (CS) associated oxidative stress in COPD. This study in Wistar rats examined cysteamine in nanoemulsions to counteract the cigarette smoke distressed microenvironment. In vivo, 28 days of cigarette smoke and 15 days of cysteamine nanoemulsions treatment starting on 29th day consisting of oral and inhalation routes were established in Wistar rats. Additionally, we conducted inflammatory and epithelial-to-mesenchymal transition (EMT) studies in vitro in human bronchial epithelial cell lines (BEAS2B) using 5% cigarette smoke extract. Inflammatory and anti-inflammatory markers such as TNF-?, IL-6, IL-1ß, IL-8, IL-10, IL-13, have been quantified in bronchoalveolar lavage fluid (BALF) to evaluate the effects of the cysteamine nanoemulsions in normalizing the diseased condition. Histopathological analysis of the alveoli and the trachea showed the distorted, lung parenchyma and ciliated epithelial barrier, respectively. To obtain mechanistic insights into the cigarette smoke COPD rat model, “shotgun” proteomics of the lung tissues have been carried out using high-resolution mass spectrometry wherein genes such as ABI1, PPP3CA, PSMA2, FBLN5, ACTG1, CSNK2A1, and ECM1 exhibited significant differences across all the groups. Pathway analysis showed autophagy, signaling by receptor tyrosine kinase, cytokine signaling in immune system, extracellular matrix organization, and hemostasis, as the major contributing pathways across all the studied groups. This work offers new preclinical findings on how cysteamine taken orally or inhaled can combat cigarette smoke-induced oxidative stress.

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Sample Preparation: Lung tissues lysates were prepared in 8M Urea lysis buffer and sonication were performed for 2 minutes 30 seconds at 45% amplitude with pulse on and pulse off for 5 seconds each.Bradford were performed of the samples to quantify the proteins. SDS-PAGE gels were run as quality control fore 10 microgram of the protein to

check the protein degradation.

Peptide Separation: Tryptic digestion was performed for 30 microgram protein using TCEP (with incubation of 1 hour at 37 degree celcius) and afterwards iodoacetate (with incubation of 15 minutes in dark at RT). Afterwards, pH was adjusted for each sample to 8. 0.25 ng/microgram of the trypsin were then added into each sample and incubated for overnoght at 37 degree celcius. An the next day, samples were dried in speed vaccuum. Dried peptides were reconstituted in 40 microlitre 0.1% FA and perfomed brief vortexing followed by spinning down. After that zip-tipping was performed aor each sample using c18 material (euilibration of c18 was perfomed using 50% ACN three times, 100% ACN three times, and 0.1% fA water three times). 9. Following equilibration, sample loading was performed of the same sample six times. After that washing was performed with 0.1% FA three times. Finally elution was performed with 40%, 50%, and 60% ACN, one time each.Spped vacuum was performed to dry the eluted peptides. After that peptide quantification was performed on a microdrop plate at 205 and 280nm. 14. After that samples were submitted to Orbitrap fusion for shortgun analysis.

Protein Characterization: The .raw files from the Orbitrap fusion was processed using maxquant. The .txt file obtained from MaxQuant was taken forward for further analysis. The analysed files from 6 groups which includes 28 samples has further been taken forward for data pre-processing. The features with >30% of missing values were removed, and further imputation was done using k-nearest neighbor (KNN; feature-wise), followed by median normalization. The normalized data was further taken forward to understand the group-wise clustering using Principle component analysis (PCA). The differential expressed significant proteins (DEPs) were identified with a threshold of $p<0.05$ and log2 fold change (log2FC) of 1.5 were taken forward to draw volcano plots and Heatmaps. The data analysis and visualization was performed in Metaboanalyst 5.0., Microsoft excel 2010, and python. The DEPs in context to inter-group and intra-group comparison has been mapped with biological pathways and gene ontologies to understand the enrichment using Reactome and KEGG databases. Furthermore, the protein-protein interaction network visualization and primary interactor curation was done from STRING with the network type as full STRING network, meaning of network edges was set as confidence, active interaction sources were kept as default with an interaction score of 0.4 (medium) with kmeans clustering.

Experiment Type: Shotgun proteomics

Species: Rattus norvegicus - 10116

Tissue: Lung (bto:0000763)

Cell Type:

Disease: Unknown

Instrument Details: Orbitrap Fusion (MS:1002416)

Protein Modifications: No PTMs

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