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Profiling silica-induced molecular events in human lung cells using the RNA-Seq approach

Carmen W H Chan[1], Stephen K W Tsui[1], Judy Y W Chan[1], Patrick T W Law[1], Winnie K W So[1], Doris Y P Leung[1] and Michael Mk Sham[2]
[1]Chinese University of Hong Kong
[2]Grantham Hospital, Hong Kong

Background: Silicosis is a prolonged, irreversible and incurable occupational disease. For better control of this deadly disease, effective and significant biomarkers could be crucial. This study showed the possible immediate molecular pathogenic events in lung epithelial cells underlying sub-lethal silica exposure from 30 minutes to 24 hours, using the high-throughput RNA-Seq approach.

Method: A549 cells were treated with crystalline silica at 20% cytotoxicity (max.) to allow the investigation of the inflammatory and fibrotic effects of silica particles. Then, total RNA was extracted and mRNA was enriched using the ribosomal RNA depletion kit. The enriched mRNA was reverse-transcribed to prepare transcriptome library for RNA-Seq analysis in an Illumina HiSeq2000 genetic analyzer. The filtered transcriptome sequence data generated was assembled and mapped to the human reference genome to determine the differentially expressed genes. Significant differentially expressed candidate genes will be verified by real-time PCR followed by comprehensive pathway analysis using DAVID 6.7.

Results: From the RNA seq results, it was found that several molecular pathways were significantly highlighted in silica exposed cellular changes. These include known pathways for silicosis such as inflammatory responses and oxidative stress responses. Other mechanisms on transcription factor regulation, aldehyde dehydrogenase and blood vessel development was newly reported to be associated with silicosis. The changes of expression level of genes under these pathways were confirmed by quantitative PCR (qPCR). In future, it is important to characterize the relationship of newly found pathways and silicosis in order to discover the novel biomarkers.

Conclusion: In this study, by RNA sequencing analysis, several pathways on transcription factor regulation, aldehyde dehydrogenase and blood vessel development were newly described to be involved in silica treatment on lung cells. Hopefully, novel biomarkers of silicosis could be discovered in future.

Biography

Carmen W H Chan has complete BSN, MPhil, RN and PhD. Dr. Carmen has won University Education Award, The Chinese University of Hong Kong, November, 2016 and Sigma Theta Tau International Honor Society of Nursing Excellence in Research Award, April 7, 2014.She is a pioneered biological nursing study on lung disease to identify biomarkers for early detection of the inflammation process and symptom control and successfully obtained an external competitive grant to pursue the study. Professor Carmen Chan has demonstrated integrated scholarship in pediatric, cancer and palliative care research which has broadly impacted on the profession, patients, families, community, and nursing education. Her main fields of research specialization include symptom management, psychosocial care, sexuality, advance care planning, pediatric care and cancer screening.

As 'symptom cluster' has been acknowledged to be at the cutting edge of science in symptom management, Professor Chan's early PhD work on the identification and management of 'symptom cluster' in patients with cancer was novel and contributed to the international development of nursing knowledge. It also laid a foundation for her subsequent studies on symptom management including the treatment of oral mucositis, skin rash, breathlessness, fatigue, nausea and vomiting, pain, anxiety and sexual function.

Professor Chan's palliative care research focuses on the promotion of advance care planning and advance directives, and targets on cancer patients, pediatric patients, older adults and the general public. Her research initiatives on this area have demonstrated excellence in design and innovation, and a great impact on the health care profession and the society. Professor Chan and her team conducted several community roadshows and surveys to promote advance care planning and advance directives in Hong Kong. Subsequently, they developed and published a health manual for advance care planning, which has been widely distributed to the public via community roadshows and to elderly centers and hospitals. In 2016, Professor Chan will launch another GRF project to carry out a large-scale population survey on the acceptance and completion of advance directive among the general public in Hong Kong

whchan@cuhk.edu.hk

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