Lung model makes headway for aerosol drug delivery

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THE first computational lung model with true-to-life moving airway walls is holding promise for the optimisation of aerosol drug delivery and improved lung surgery outcomes for patients with respiratory diseases.

Funded by the Asthma Foundation WA, the model forms the foundation of an ongoing project by Curtin University's Health Innovation and Fluid Dynamic research groups, in collaboration with the Telethon Institute for Child Health Research.

Lead researcher Ben Mullins from Curtin's School of Public Health says research began with the development of computational fluid dynamic models for other aerosol science applications.

"We realised that the models we'd developed were much more advanced than what's currently used in aerosol drug delivery and respiratory science," Associate Professor Mullins says.

According to A/Prof Mullins, previous airway models used static geometries which created an artificially simplified representation of respiratory function and compromised accuracy when used for modelling the deposition of aerosol drugs and environmental pollutants.

"The expansion and contraction of the lungs is responsible for the flow of air, and any particles present in the air, in and out," he says.

"If we want completely accurate computer models for studying aerosol drug delivery this must be taken into account."

Using high resolution computerised tomography (CT) scans of live animals or humans, they applied fluid dynamics modelling to create a moving mesh model; breaking the surface of the airway into discrete regions to then allow the simulation of physiologically accurate movement.

Simulation of aerosol drug deposition patterns using the moving mesh model for rats was shown to give results with a stronger correlation with in vivo animal data than results produced by standard static lung models, supporting the usefulness of the model in the review of aerosol drug properties and delivery mechanisms for sufferers of chronic lung diseases.

"Several hundred million dollars a year of asthma inhalers are sold in Australia and at the moment 90–95 per cent of the medication doesn't get deep into the airways where it is needed; now that we have accurate models for both the airflow and aerosol deposition, we can start to generate the best particle properties and better design inhalers," he says.

The group also hope that personalised lung models, created using individual patients' CT scans, may become a tool for use in surgical intervention for lung conditions.

"Rather than just standard lung function tests we can actually look at localised airflow, simulating their existing airways and the effect of having a section of the lung removed."

Results of the study were published in the *Journal of Aerosol Science*.

More information: www.sciencedirect.com/science/ … ii/S0021850213001341

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