

Background

The use of physical models has become a popular idea for use in human and animal inhalation studies in recent years. The benefits include a reduction in live animal testing and associated costs, but for such a model to be useful it must be anatomically accurate in recreating the respiratory tract of the animal being studied. Past models have been created from photos or casts of deceased animals, these may be inaccurate due to structural changes that occur after death. The goal of this project was to recreate the first animal model based on an actual CT scan of a live animal, and then reproduce the respiratory tract as a plastic model with 3D printing techniques. Particle deposition studies were also conducted using these models.

Relevance

The benefits of using an physical model as a surrogate for live animal would be many. Particle deposition studies could be conducted without the use of live animals, as the total and regional deposition of particles would be determined from studies using the model itself. Information such as particle size, location, and amounts would shed insight on issues such as infectivity and toxicology, as these are closely related to the particle size and location of deposition in the models and animals.



Results

The final product was obtained through a collaboration of several different agencies. The animal CT scans were obtained from NIH located at Fort Detrick, MD. The scans were converted to 3D format by the ECBC's ADM Branch, that produced a detailed plastic model with a 3D printer. Aerosol testing of the model was conducted by the ECBC's SSAT Branch, the data was then analyzed against existing inhalation data for it's accuracy.

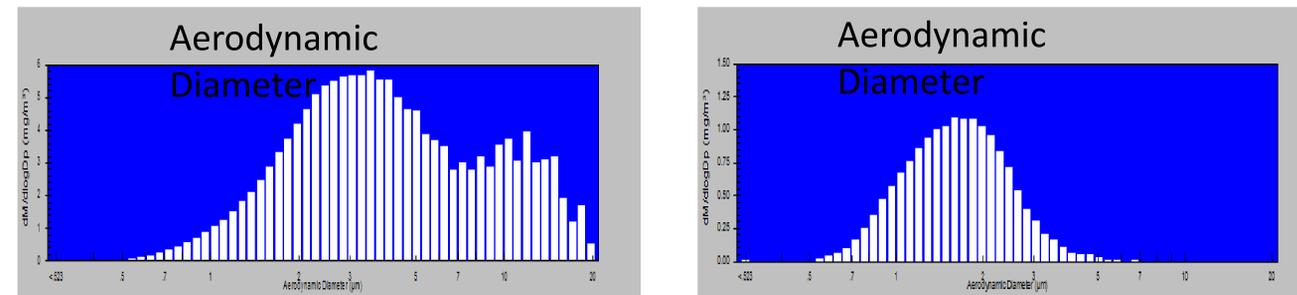


Figure: Particle size distributions as measured by an APS Model 3321 Aerodynamic Particle Sizer (APS). Left graph is the size distribution for the challenge aerosol (upstream) of human model, right graph is downstream distribution, showing high deposition of larger particles in the model.



Collaboration and Future work

This is a collaborative effort between ECBC (SSAT Branch, ADM, Operational Toxicology Branch), National Biodefense Analysis and Countermeasures Center (NBACC) at Ft. Detrick, NIH, MRICD, Hopkins and Stanford University. This work will lead to future proposals to create similar models for a number of other animals, and the development of new methods for measuring particle deposition with radioactive tracers. Future work would also include development of high fidelity computer models of particle deposition in animals and humans. In addition, other agencies have expressed interest in obtaining similar models for their own use, leading to future collaboration and funding opportunities.

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