The Why's and Wherefore's of "Hot Spots" on the Radioaerosol Inhalation Lung Scan

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Historically, one of the overriding problems with performance and interpretation of the Radioaerosol Inhalation Lung Scan has been 'hot spots'. What are they? What causes them? What do we do about them?

It has long been thought that 'hot spots' were the result of clumping of particles, particles that were either too large or which were sticking together. I would suggest that neither answer is appropriate.

At Medi/Nuclear Corp. we have been manufacturing radioaerosol inhalation devices for use in Nuclear Medicine for over 10 years. In addition to manufacturing the units, we also have the ability to do our own in-house testing of the units for particle size and distribution as well as nebulizer generation rate. We, like everyone else, depend on some of the major medical centers to provide clinical results.

Because of the hands-on nature of our research and our involvement in the papers presenting the results, we have come to the conclusion that particle size, largely, determines the differential deposition in either the upper or lower respiratory tract. 'Hot spots', rather than being related to particle size, are almost entirely a function of velocity.

This velocity comes about either intrinsically or extrinsically. Intrinsically, it results from conditions within the patient's lungs. This might be mucous plugs, tumor invasion or a narrowing of the passages by any number of disease states. Extrinsically, the cause is uncontrolled deep breathing or tachypnea. In the first instance, as the aerosol passes a narrowing of the breathing passage, it accelerates. Immediately upon passing the narrowing, it decelerates. Upon decelerating, an eddy current is created which deposits the aerosol on the distal side of the narrowing. In the second instance, an uncontrolled deep breath is by its very nature a high velocity breath. In this case the aerosol will be deposited anywhere a bend is too sharp for the particle's own inertia to allow it to turn. This is usually in the throat or at the carina.

If the trachea is visualized, it generally indicates the presence of excessively large particles, and if these particles are sufficiently large or represent a sufficiently large portion of the particle size distribution, peripheral penetration will be impaired.

Based on the above observations and hypotheses, we set out to redesign our nebulizer to both produce very small particles and to compact the particle size distribution. The results have been presented in papers from Cedars-Sinai Medical Center in Los Angeles. We feel we have now produced the two best aerosol delivery systems currently available, the Aero/Vent+ and the Insta/Vent. Either unit will provide particles

almost entirely below 1 micron, and the Insta/Vent will delivery them to the patient in significantly less time.