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Factors Influencing Aerosol Ventilation Imaging

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Aerosol lung studies performed with currently available commercial delivery systems frequently have significant central deposition of activity degrading image quality. We studied the factors which might influence this.

In 20 consecutive adults undergoing aerosol studies with a commercial aerosol system with a downstream bag, jet nebulizer, 12" hose, mouthpiece and nose clamp we measured tidal volume and respiratory rate, holding constant delivery parameters: 1110 MBq Tc-99m DTPA, suspended in 3 mL, delivery rate 8 L/min of O2, nebulization time was that required to increase the count rate to at least three times the residual activity of MAA. Tidal volumes ranged from 260 mL to 1652 mL and respiratory rates ranged from 10 to 68 per minute. Central deposition appeared in the tracheobronchial tree in all and could not be related to tidal volume or respiratory rate. In 5 subsequent patents we moved the bag upstream to the nebulizer with no effect. We then interposed a one way valve at the mouthpiece, preventing mixing of exhaled breath with the radioaerosol. The central deposition disappeared.

We used a cascade impactor to measure mass median aerodynamic diameter for 9 nebulizer systems. All but 1 generated particles more than 70% of which had a diameter less than 1µ. Holding all delivery factors constant, we then analyzed particles from the same nebulizer that had been mixed with exhaled breath:

PARTICLE SIZE DISTRIBUTION

Particle Size	System Using Room Air	Mixed with Expired Air
Less than approx. 0.2µ	16.40%	3.68%
Approx. 0.2 to 1.0µ	75.79%	56.53%
Approx. 1.0 to 5.0µ	6.98%	38.67%
More than approx. 5.0µ	0.83%	1.12%

Particles from 0.5 to 3.0µ in size are most suitable for aerosol imaging. These results clearly show that mixing exhaled breath with nebulized particles increases the effective diameter. Preventing the mixing by use of a one way valve at the mouth circumvents this.

Presented at the 44th Annual Meeting of the Society of Nuclear Medicine, San Antonio, TX

June 1-5, 1997