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OPINIONS & COMMENTARY

Respirable particles in the excimer laser plume

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by Michael J. Taravella, MD

Excimer laser surgery for the correction of refractive errors is becoming one of the most widely performed ocular procedures. The surgery involves ablation of the corneal stroma and, in some cases, the corneal epithelium. Concern has increased about the potential health risks faced by excimer laser surgeons while performing photorefractive keratectomy and laser in-situ keratomileusis.

In previous research, colleagues and I have demonstrated that at least one virus, oral polio vaccine virus, can survive excimer laser ablation and remain infectious. Other viruses have been investigated with mixed results as to the viability of the recovered viral particles. However, one area that has been overlooked is whether the laser plume itself poses a health risk.

A recently published study of ours (Taravella MJ, Viega J, Luiszer F, et al. Respirable particles in the excimer laser plume. J Cataract Ref Surg. 2001;27(4):604-607.) is the first report of excimer laser debris particle measured directly from electron photomicrographs.

The size of an inhaled particle is the most important aspect in determining where it will be deposited in the respiratory tract. Most particles of 5 Âµm or more are generally deposited on the walls of the nasopharnyx, trachea, and bronchial bifurcations. Particles smaller than 2 Âµm in diameter are deposited in the respiratory bronchioles and alveoli. Our data suggest that the excimer laser generates particulate matter in this range and, therefore, it could be deposited deep in the lungs once inhaled. However, particles less than 0.5 Âµm in diameter tend to be exhaled.

Many factors influence the host response to inhaled particulate matter, including particle composition (organic vs. inorganic), particle density in a given volume of air, duration of exposure, and individual susceptibility. The response can vary from clearance of the particulate matter to fibrosis of lung tissue or a hypersensitivity reaction.

Our study did not determine whether inhalation of corneal debris in the excimer laser plume poses a health hazard to humans. However, other investigators have examined the potential hazards of smoke and debris produced by various laser systems. These studies include an analysis of long-term inhalation of carbon dioxide laser smoke on the lungs of rats. Fine particulate matter produced by tissue vaporization was deposited in the alveoli of the study animals and produced pathologic changes consistent with interstitial pneumonia, bronchiolitis, and emphysema. The severity of these changes increased proportionately as a function of the duration of exposure; the changes were similar to pulmonary changes in humans caused by inhalation of fine particles of asbestos, tobacco, talc, and other material. Surgeons who smoke or have obstructive pulmonary disease may be at higher risk for lung damage, since particle

deposition tends to occur deeper in the lungs and alveoli and more particulate debris is retained in smokers than in nonsmoking subjects.

In summary, our study and others demonstrate that the excimer laser produces particulate debris. While there are anecdotal reports of excimer laser surgeons developing a chronic cough of other illness, there are no human or animal studies indicating that inhalation of the excimer laser plume is harmful. Given the uncertainties, we recommend the use of a plume-evacuation system, especially if a plume evacuator is not an integral part of the excimer laser system. Another reasonable precaution surgeons should take is to wear a mask capable of filtering out small particles. The precautions are relatively simple and similar to those suggested for surgeons using the carbon dioxide laser system.

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