Mask Ventilation and Dispersion of Exhaled Air

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Mask ventilation is associated with spreading of severe respiratory infection (1, 2). We simulated the dispersion pathway of exhaled air, using laser visualization of smoke particles, during resuscitation in a high-fidelity human patient simulator (3). Exhaled smoke leaked through the expiration diverter of a Laerdal resuscitator (Laerdal Medical, Wappingers Falls, NY) and was carried caudally by a mean ($\pm$ standard deviation) distance of 20 $\pm$ 2.8 cm (20 trials) (Figures 1a and 1b and Video E1 in the online supplement). A second person performing chest compression would be exposed to exhaled air that is potentially infectious. The addition of a breathing filter eliminated the spread of expired smoke from the resuscitator (Figures 2a and 2b and Video E1). However, leakage of exhaled air was observed at the interface between the mask and face (Figure 3 and Video E2) by 35 $\pm$ 9.1 cm in the transverse plane. Therefore, during mask ventilation, the addition of a breathing filter is helpful in minimizing exhaled air dispersion. The rescuer should be aware of leakage from the face mask and adopt strict infection control measures during resuscitation of patients with severe respiratory infections. Results of this work have previously been published as an abstract (4).

Author disclosures are available with the text of this article at www.atsjournals.org.

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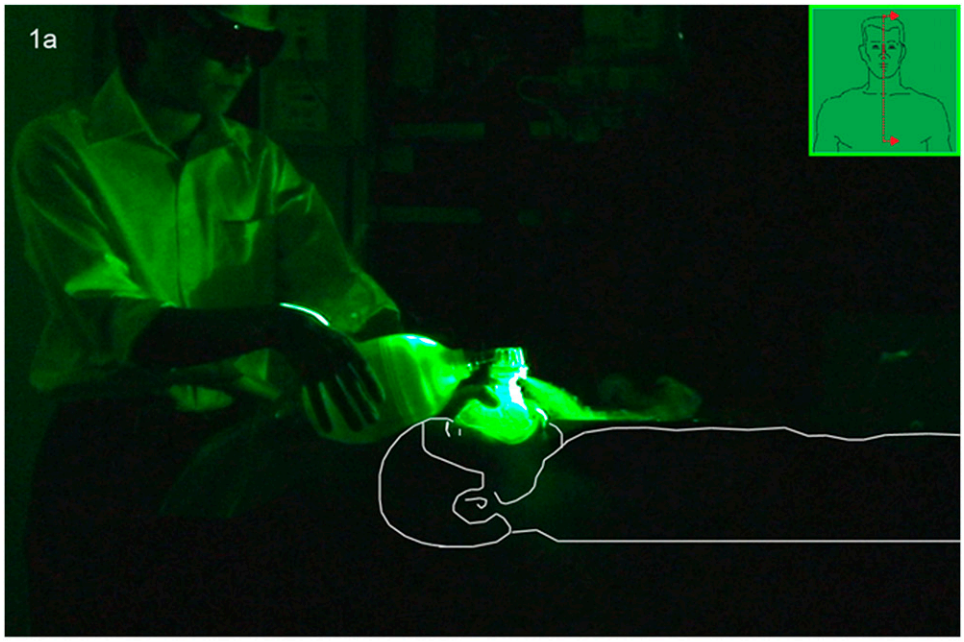

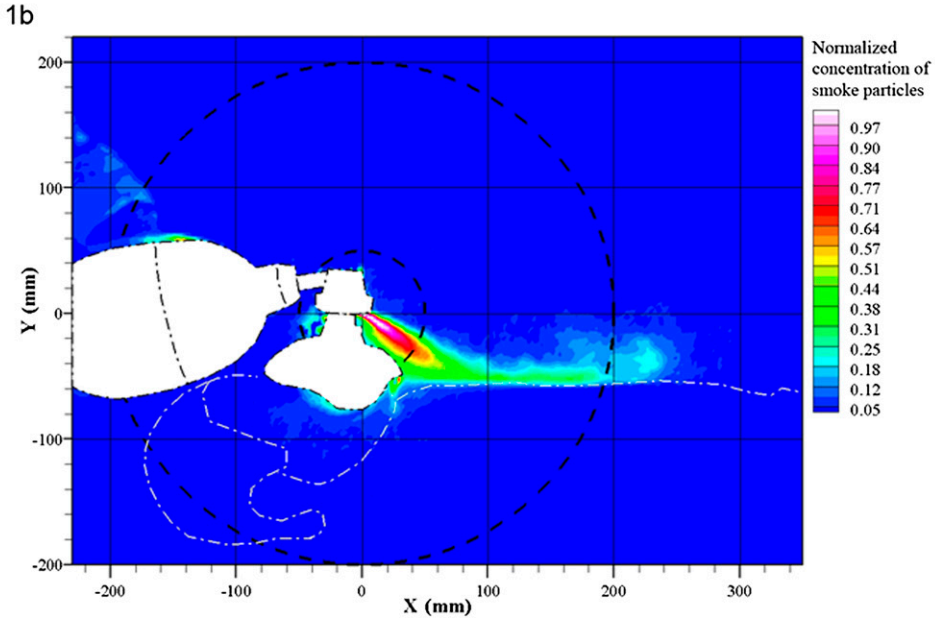

Figure 1. (*a*) The exhaled air plume was indicated with intrapulmonary smoke, and was revealed by the laser light sheet. The image was captured by a high-definition camera positioned to the right of the human patient simulator. (*b*) Normalized concentration of smoke particles in the plume was estimated from the light scattered by smoke particles. *White* and *red zones* represent regions containing 100% and 70% of exhaled air, respectively. *Deep blue zone* is essentially free of exhaled air. The lung compliance was set as 35 ml/cm H_2O. The recorded tidal volume and peak airway pressure during mask ventilation (20 trials) were 347 $\pm$ 32 ml and 25 $\pm$ 6 mm Hg, respectively.

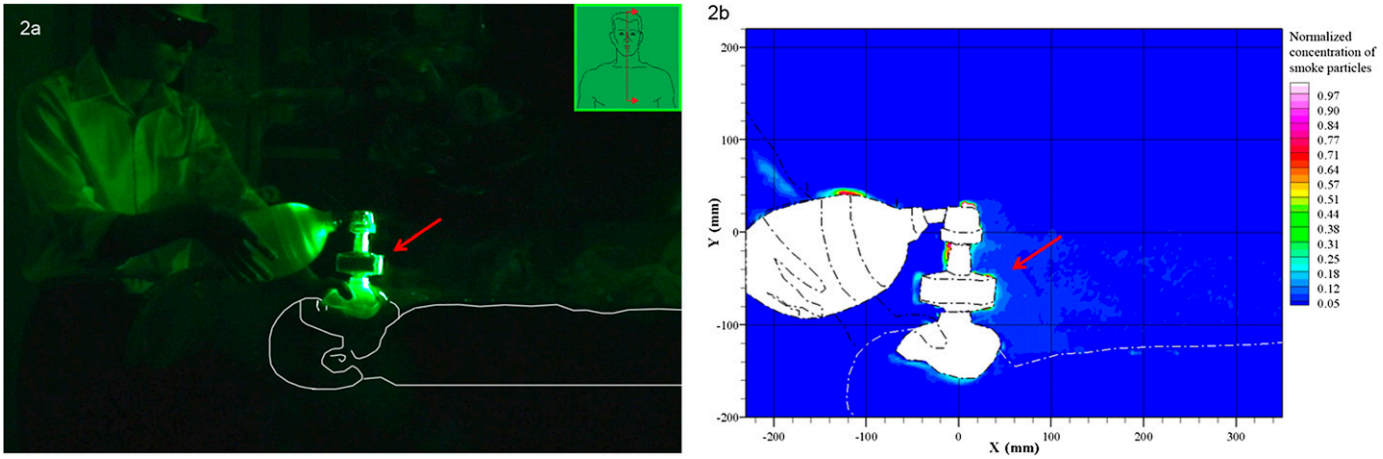

Figure 2. The addition of a breathing filter (*arrow*) eliminated leakage from the expiration diverter.

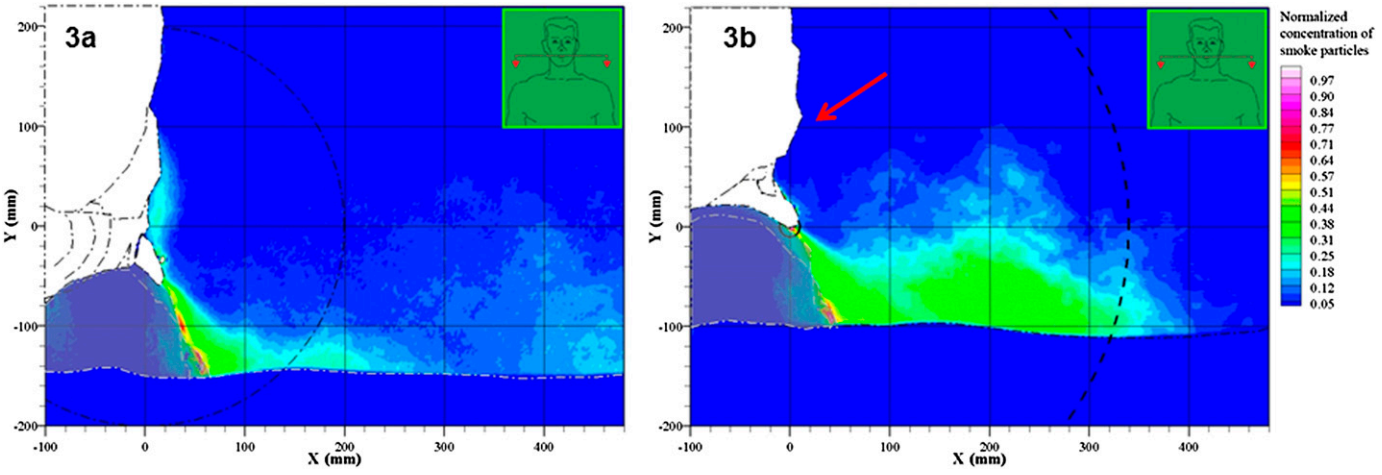

Figure 3. Leakage of exhaled air through the mask and face interface along the transverse plane during mask ventilation with (*b, arrow*) and without (*a*) breathing filter.