Introduction. Lidocaine aerosols have been ineffective at preventing airway constriction provoked by non-reflex stimuli, implying that at the concentrations achieved in vivo, the drug was not sufficiently potent to impair mediator release or directly relax smooth muscle. It has been suggested that, because of increased potency or more selective actions, other local anesthetics may be preferable to lidocaine in this regard. We have previously employed an inhalational challenge with 10% citric acid aerosols to elicit a primarily reflex bronchoconstriction that is blocked or markedly attenuated by i.v. atropine and lidocaine or by aerosols of lidocaine.

In the present study, we have used a longer period of citric acid challenge (5 min.) to evoke a primarily direct bronchoconstrictor effect and have used this challenge to compare the relative effectiveness of aerosols of lidocaine, hexylamine, bupivacaine, and procaine at preventing airway constriction in dogs with nonspecific airway hyperreactivity.

Methods. The studies were performed in intubated Basenji-Greyhound (BG) crossbred dogs (5) during thiopental anesthesia, and challenges were delivered about a week apart. Aerosols were delivered into the inspiratory side of a circle anesthesia system just proximal to the endotracheal tube. The local anesthetics (1% solutions) were administered as aerosols for a 10 min. pretreatment period. Two min. later, the dogs were challenged for 5 min. with 10% citric acid aerosols. In other experiments, atropine (2 mg/kg) was administered i.v. 3 min. before citric acid challenge, or an isoproterenol (0.02%) aerosol was inhaled for 5 breaths immediately before challenge. Dynamic compliance (Cdyn) was calculated by dividing tidal volume by the pressure change between points of zero flow, and pulmonary resistance (Rl) by the method of Von Neergaard and Wirz. Rl and Cdyn were measured at 5 min. intervals for 15 min. after challenge; drug effects were compared on the basis of the average increase in Rl (ΔRl) during this time. Blood drug levels were determined by gas chromatography.

Results. In control experiments (10 min. saline aerosol), citric acid challenge elicited a large increase in Rl and decrease in Cdyn (Fig. 1). Local anesthetic aerosols had no significant effect on citric acid-induced increases in Cdyn. Lidocaine and hexylamine significantly reduced citric acid-induced ΔRl, but bupivacaine and procaine aerosols afforded no protection (Fig. 2). Citric acid-induced ΔRl was following pretreatment with saline, lidocaine, hexylamine, isoproterenol, and atropine were 3.3±0.8, 2.1±0.6, 2.1±0.6, 0.7±0.3, and 3.1±0.6 cm H2O/L/sec., respectively. Blood levels of lidocaine, hexylamine, and bupivacaine were maximal at the end of the 10 min. pretreatment aerosol and were 0.2±0.2, 0.2±0.06 and 0.6±0.06 μg/ml, respectively.

Discussion. Although the 5 min. citric acid challenge was not blocked by atropine, it was prevented by pharmacologic means (isoproterenol). The protection afforded by local anesthetics was much less than with isoproterenol and did not parallel their potency as local anesthetics, as demonstrated by the failure of bupivacaine to afford any protection (Fig. 2). We conclude that local anesthetic aerosols are relatively ineffective against other than reflex bronchoconstriction, and that bupivacaine, hexylamine, and procaine offer no advantage over lidocaine in this regard.