Comparison of the influence of halothane and isoflurane on airway transepithelial potential difference

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Abstract: Bidirectional transport of Na⁺ and Cl⁻ ions by the epithelium controls production and composition of airway surface liquid and airway transepithelial potential difference and in these ways supports mucociliary transport. Volatile anesthetics are able to inhibit epithelial ion transport processes when applied at high concentration and have been suggested to elicit depression of airway clearance and both these effects could be involved in postoperative pulmonary complications. The goal of these studies was to reveal possible influence of halothane and isoflurane at lower concentrations on electrogenic ion transport in airway epithelium. These studies were performed on the isolated rabbit tracheal wall mounted in the Ussing chamber. The reaction of the preparation to the gentle mechanical stimulation performed as a jet flux was examined without or in the presence of anesthetics at concentration equivalent to 0.5 minimal anesthetic concentration of volatile anesthetics in pulmonary alveoli (MAC), 1 MAC, 2 MAC, 5 MAC and 10 MAC. The volatile anesthetics at concentrations equivalent to 5 and 10 MAC affected airway transepithelial potential difference and influenced hyperpolarization or depolarization reactions which occurred after mechanical stimulation. The above effects were present when Na⁺ transport was inhibited by amiloride. The disturbed epithelial Cl⁻ transport may be proposed as an explanation of the action of volatile anesthetics on electrophysiological parameters of the isolated tracheal wall although the influence of anesthetics on tachykinin secretion from C-fiber endings, which are present in the preparation, should also be taken into consideration. The long-lasting action (tens of minutes) of volatile anesthetics on the isolated tracheal wall should be also studied in the future as a model of airway reaction to prolonged volatile anesthesia.

Key words: volatile anesthetics, halothane, isoflurane, transepithelial potential difference, airway epithelium, airway ion channels, C – fiber endings