CORRESPONDENCE

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Cricoid Pressure for Preventing Gastric Insufflation in Infants and Children

To the Editor:—In a recent study of the effectiveness of cricoid pressure for preventing gastric inflation,[1] the single, nonblinded investigator relied on breath sounds during cricoid pressure to determine the adequacy of ventilation and on detection of a "gurgle" by auscultation of the upper abdomen to indicate gastric insufflation. Because the investigators did not measure exhaled volumes or volumes of gases in the stomach and there is no mention of end-tidal CO_2 or CO_2 waveform, one cannot be certain that cricoid pressure did not occlude the patient's airway. Sounds from the lungs or esophagus can be misleading because they are transmitted easily in infants and children.[2] Normal breath sounds can be heard over the epigastrium, whereas esophageal sounds may be misinterpreted as normal breath sounds.

That the single investigator in Moynihan *et al.*'s[1] study quickly rediscovered that the amount of pressure applied certainly does vary from application to application and probably was less in the younger infants testifies to the need for gentle rather than firm application of cricoid pressure to prevent gastric insufflation, as we emphasized 19 yr ago.[3] In that study,[3] we compared the volumes of exhaled gas and the volumes of gas in the stomach after two identical periods (with and without cricoid pressure) of intermittent positive-pressure ventilation by mask and demonstrated unequivocally, for the first time, the efficacy of cricoid pressure for preventing gastric insufflation.

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References

1. Moynihan RJ, Brock-Utne JG, Archer JH, Feld LH, Kreitzman TR: The effect of cricoid pressure on preventing gastric insufflation in infants and children. ANESTHESIOLOGY 78:652–656, 1993
2. Uejima T: Esophageal intubation. Anesth Analg 66:481–482, 1987
3. Salem MR, Wong AY, Mani M, Sellick BA: Efficacy of cricoid pressure in preventing gastric inflation during bag mask ventilation in pediatric patients. ANESTHESIOLOGY 40:96–98, 1974

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Does the Potency of Fentanyl Vary with Different Inhalational Agents?

To the Editor:—I was interested to read the recent papers by Glass *et al.*[1] and McEwan *et al.*[2] describing their investigations of the potency of fentanyl. They elegantly combined a computer-assisted continuous infusion scheme for achieving stable plasma fentanyl concentrations with the well-established method of evaluating the potency of inhalational anesthetic agents by suppression of movement to surgical incision. Comparison of the findings of the two studies reveals an interesting difference in the plasma fentanyl concentrations required for equivalent levels of movement suppression when combined with either nitrous oxide or isoflurane.

Glass *et al.*[1] demonstrated that in the presence of 70% inhaled nitrous oxide, the minimal steady-state plasma concentration of fentanyl required to prevent 50% of patients from moving in response to skin incision was 3.26 ng/ml (67% fiducial limits 2.4–4.1 ng/ml). Assuming that 70% nitrous oxide was administered for at least 10 min before the response to incision was assessed, its end-tidal concentration should have reached at least 95% of inspired concentration, *i.e.*, 66.5%. Assuming the widely accepted MAC value for nitrous oxide of 105%, its contribution to suppression of the movement response to incision should therefore have been approximately 66.5/105, equivalent to 0.63 MAC. It is generally recognized that in terms of their contribution to standard MAC, the end-tidal concentrations of nitrous oxide and the common volatile agents are directly additive. This certainly has been shown for nitrous oxide and isoflurane,[3] and thus the end-tidal nitrous oxide concentration of 66.5% would be expected to be equivalent to 0.63 MAC isoflurane.

The mean ages of the patients in the two studies were comparable (33 and 36 yr), and the MAC of isoflurane without fentanyl in the

study by McEwan and colleagues[2] was 1.23%. An inspired concentration of 70% nitrous oxide should therefore be equivalent to 0.63 × 1.23 = 0.77% end-tidal isoflurane in terms of its contribution to MAC. Inspection of figure 3 (which plots isoflurane MAC against plasma fentanyl concentration) of McEwan *et al.*'s study shows that the plasma fentanyl concentration required to produce a reduction in isoflurane MAC to 0.77% is approximately 0.9 ng/ml (95% confidence interval 0.5–1.3 ng/ml). This contrasts dramatically with the minimal steady-state plasma fentanyl concentration of 3.26 ng/ml for achieving the same patient response end-point (and equivalent anesthetic "depth"?) in conjunction with 70% (0.63 MAC) nitrous oxide. This difference lies well beyond the 95% confidence interval limits quoted for the plasma fentanyl concentration. This implies either that the interactions between nitrous oxide and fentanyl and between isoflurane and fentanyl in generating a 50% suppression of response to surgical incision are dramatically different, or that sub-MAC fractions of nitrous oxide and isoflurane are in fact not equivalent.

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References

1. Glass PSA, Doherty M, Jacobs JR, Goodman D, Smith LR: Plasma concentration of fentanyl, with 70% nitrous oxide, to prevent movement at skin incision. ANESTHESIOLOGY 78:842–847, 1993
2. McEwan AI, Smith C, Dyar O, Goodman D, Smith LR, Glass PSA: Isoflurane minimum alveolar concentration reduction by fentanyl. ANESTHESIOLOGY 78:864–869, 1993
3. Stevens WC, Dolan WM, Gibbons RT, White A, Eger EI, Miller RD, deJong RH, Elashoff RM: Minimum alveolar concentrations (MAC) of isoflurane with and without nitrous oxide in patients of various ages. ANESTHESIOLOGY 42:197–200, 1975

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In Reply:—Using a MAC value for nitrous oxide of 105% and assuming that the interaction of nitrous oxide with isoflurane is simply additive, it appears that the potency of fentanyl does vary according to whether it is combined with nitrous oxide or isoflurane.

It recently has been demonstrated that the nitrous oxide MAC in rats is greater than that previously reported. Gonsowski and Eger have shown that the MAC in several strains of rats is almost 50% higher than that previously reported.[1] Although that study involved rats, it may be hypothetized that the values extrapolated to humans also are much greater than previously thought. Schwilden and Ropcke have reported on the interaction between isoflurane and nitrous oxide in suppressing the electroencephalogram signal.[2] Extrapolation of their data also supports a nitrous oxide MAC value greater than 105%. Thus, the actual MAC contribution of 67% nitrous oxide may well be much less than 0.63 MAC, thereby explaining the difference in the potency of fentanyl when it is combined with nitrous oxide or isoflurane. Another explanation for the difference in the potency of fentanyl with nitrous oxide and isoflurane is that the interaction between nitrous oxide and isoflurane for MAC determinations is not simply additive. This is supported by two recent publications that have shown that the interaction between nitrous oxide and isoflurane, again in rats, in providing 1 MAC is not linear.[3,4] If this interaction is not linear, then the simple calculations done by Sanders no longer hold.

It is our contention that the potency of fentanyl is not altered by the anesthetic with which it is combined, but rather that the explanations above are responsible for the apparent discrepancy suggested by Sanders.

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References

1. Gonsowski CT, Eger EI: Nitrous oxide minimum alveolar concentration in rats is greater than previously reported (abstract). ANESTHESIOLOGY 79:A424, 1993
2. Schwilden H, Ropcke H: The interaction between isoflurane and nitrous oxide on the electroencephalogram is additive (abstract). ANESTHESIOLOGY 79:A350, 1993
3. Cole DJ, Kalichman MW, Shapiro HM: The nonlinear contribution of nitrous oxide at sub-MAC concentrations to enflurane MAC in rats. Anesth Analg 68:556–562, 1989
4. Cole DJ, Kalichman MW, Shapiro HM, Drummond JC: The nonlinear potency of sub-MAC concentrations in decreasing the anesthetic requirements of enflurane, halothane, and isoflurane in rats. ANESTHESIOLOGY 73:93–99, 1990

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