Breathing Nitrous Oxide during Closure of the Dura and Cranium is Not Indicated

To the Editor:—In their recent article, Skahen et al. reported that withdrawing nitrous oxide from inspired gases reduced intracranial pressure (ICP) when a pneumocephalus which contained air and presumably nitrous oxide was present. They concluded that reabsorption of nitrous oxide from the pneumocephalus was the reason that ICP fell. They recommended that nitrous oxide should be present in inspired gases of patients undergoing craniotomy so that ICP can be reduced when nitrous oxide is withdrawn from inspired gases. However, the authors did not demonstrate that a pneumocephalus which forms while nitrous oxide is present in inspired gases contains substantial amounts of nitrous oxide, or that withdrawing nitrous oxide from inspired gases results in a lower ICP than if nitrous oxide had never been present in inspired gases. Thus, their recommendation is not supported by their data, and must be considered speculation.

Under certain conditions (see next paragraph, below), the data presented by Skahen et al. actually argue against the recommendation that nitrous oxide should be present in inspired gases until after closure of the dura. The data for their rabbit group III indicate that, when ICP initially is 1 mmHg, trapping 0.4 ml of air beneath a closed dura and cranium increases ICP to 15 mmHg if nitrous oxide is continued in inspired gases. Later, when nitrous oxide is withdrawn from inspired gases, ICP falls from 15 mmHg to 6 mmHg. By comparison, the data for their rabbit group II indicate that, when ICP initially is 1.5 mmHg, trapping 0.4 ml of air beneath a closed dura and cranium increases ICP to 7 mmHg or less if nitrous oxide is not present in inspired gases. Clearly, rabbits breathing nitrous oxide after dural closure do not benefit, and may be worse off than those not breathing nitrous oxide.

The above considerations are valid for situations where the intracranial gas space freely communicates with ambient air through the surgical site. The above considerations also are valid where the surgical site is located inferiorly (pneumocephalus formed by the “inverted pop bottle” route) and air entry into the surgical site is not limited by equilibration of nitrous oxide with air in the intracranial space. Thus, when these conditions exist, the recommendations of Skahen et al. are not supported.

The recommendations of Skahen et al. may have merit if other conditions exist. For a surgical site located superiorly, the recommendations may have merit if nitrous oxide diffusing from brain tissue into intracranial air completely equilibrates with that air prior to closure of the dura and cranium. For a surgical site located inferiorly (where air enters the intracranial space via the “inverted pop bottle” route) the recommendations may have merit if diffusion of nitrous oxide from brain tissue into intracranial air is the primary factor that limits the volume of air entering the cranium. If so, equal volumes of intracranial gas would be present in patients breathing nitrous oxide (where the pneumocephalus would be air-nitrous oxide) compared to patients not breathing nitrous oxide (where the pneumocephalus would be air). Later withdrawal of nitrous oxide from inspired gases would reduce the volume of the air-nitrous oxide pneumocephalus providing a lower ICP than in a patient not breathing nitrous oxide. However, Skahen et al. present no evidence that these latter conditions exist. To the contrary, one evidence that they cite suggests that nitrous oxide diffusing from brain tissue does not equilibrate with intracranial air prior to closure of the dura and cranium but, rather, that in a patient breathing nitrous oxide the intracranial gas is chiefly air prior to closure.2

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REFERENCES

In Reply:—Artru’s criticism of Skahen et al.’s demonstration that nitrous oxide withdrawal can lower intracranial pressure (ICP) in the presence of pneumocephalus is based upon careless reading of our paper and an attempt to support his interpretation of the factors leading to an ICP increase in his case report.1,2 The crucial point in our paper is that equilibration of N2O within the isolated intracranial air pocket is essential for N2O removal from inspired gases to effect a reduction in the total volume of the intracranial gas cavity at the end of a neurosurgical