Editorial Views

For Oxygen Security

The substitution of an artificially composed atmosphere for ordinary air as the respiratory medium introduces the hazard of errors in creating the composition of the inhaled gas mixture. This hazard has been accepted in the administration of inhalation anesthesia, but it must be acknowledged and all efforts bent toward eliminating the risks involved. The consequences of failure to do so are catastrophic, and their occurrence well documented.¹ ²

A major element of risk accompanies the use of mixtures containing nitrous oxide. This is because the low potency of this gas demands its use at concentrations approaching the maximum allowed by the need for oxygen. Errors in metering which result in the delivery of higher nitrous oxide concentrations than desired will encroach on the vital oxygen supply. Conversely, administration of nitrous oxide at suboptimal potency is a less-than-desirable way to assure adequate oxygen.

At least two solutions have been offered. The use of cylinders of premixed nitrous oxide and oxygen, proposed by Barach and Rovenstine ³ and brought into practice by Tunstall ⁴ is available but cumbersome, and not accurate under all conditions.⁵ Matteo, Gissen and Lee ⁶ in this issue of Anesthesiology, offer an alternative based on the incorporation of an accurate mixer for nitrous oxide and oxygen into the anesthesia machine. This system produces a constant ratio of the concentrations of the two gases at the point of use, and permits delivery of a fixed concentration of nitrous oxide and oxygen as if it were a single gas. Adoption of 25 per cent oxygen as the preset minimum concentration of the mixer output provides a source of gas in the anesthetic range with an oxygen supply reflecting the needs of partial rebreathing systems and the now-well-recognized possibility of increased A-aDO₂ during anesthesia. Other gases, including additional oxygen, can be added in use, or the preset concentration of oxygen can be adjusted to higher values if this is deemed physiologically sound. The system described adapts the ratio mixer principle of Rackow, Salmite, and Lee ⁷ in a way which permits direct reading of the total gas flow and its final oxygen concentration when binary mixtures are in use.

This system continues the trend, vital to the development of modern anesthesia, of providing information and precision for the safe use of our highly potent agents. In doing so it incorporates and extends the principles of the “master–slave” proportioning regulator system first described in 1962. ² That fail-safe system adjusts the pressure of the nitrous oxide to be exactly equal to that of the oxygen. The less
comprehensive, non-master–slave systems used by commercial gas machine manufacturers shut off the nitrous oxide abruptly when oxygen pressure falls below a preset low value. Each provides assurance that asphyxiating gas mixtures will not be delivered should oxygen supplies fail completely. The present contribution adds assurance that the oxygen which is available will in fact be added to the mixture in adequate amounts.

Fail-safe systems are inherently simple. Their cost is not great, and once installed they have proved highly reliable and trouble-free. Nevertheless, adoption of devices to prevent the dangers of failure of the oxygen supply is not universal. They are sold as optional rather than standard equipment on new gas machines, and conversion of existing equipment has not been widely undertaken. It is time that no anesthesia machine be considered adequate without incorporation of some form of oxygen security. No manufacturer can any longer consider that he is providing a modern and complete product unless it includes this protection, and no anesthesiologist should accept one which does not. In this sabbatical year since the description of a completely successful fail-safe device, the loss of a single patient because of its absence is entirely unjustifiable and must be condemned.

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References