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Title : NORMOCARBIA IN CHILDREN DURING ANESTHESIA: A NEW METHOD

Authors : John A. Youngberg, M.D.

Affiliation : Emory University School of Medicine, Department of Anesthesia, Anesthesia for Surgical Specialities, 1364 Clifton Road, Atlanta, Georgia 30322

Introduction. There is a fair degree of controversy over fresh gas flow (FGF) and minute ventilation (MV) requirements necessary to produce normocarbia with various pediatric anesthesia systems and formulae have been based on age, sex, weight, body surface area and carbon dioxide production.[1-5] Because this controversy concerning FGF and MV exists and a wide range of pediatric equipment may not be readily available to some anesthesiologists, this study was designed to demonstrate the FGF and MV rates necessary to produce normocarbia in children with the Air Shields Ventimeter ventilator and a partial rebreathing system.

Methods. This study was approved by the Human Investigations Committee and informed consent was obtained. Eighteen ASA class I or II pediatric patients aged 3-13 years undergoing peripheral surgery in the supine position were studied. All patients were premedicated with morphine 0.1 mg/kg and atropine .01-.02 mg/kg given intramuscularly approximately 45 minutes prior to anesthesia. Anesthesia consisted of halothane and nitrous oxide in oxygen. Fresh gas flow was set at 130 ml/kg/min in groups I and II and 90 ml/kg/min in group III. All patients were ventilated at a rate of 15 breaths/min to a peak inspiratory pressure of 20 cm H_2O utilizing an adult Air Shields Ventimeter ventilator and a partial rebreathing system. (Fig. I) The I: E ratio was maintained at 1: 2. Minute ventilation was measured with an in-line Wright's Respirometer located at the endotracheal tube. Arterial blood gas determinations were made at 30 and 60 minutes after initiating mechanical ventilation. All samples were analyzed for P_aCO_2, P_aO_2 and base excess. Samples were stored on ice, analyzed on a Corning 175 blood gas analyzer and corrected for patient temperature.

Results. All results are presented as the mean ± one standard deviation. In group I (six patients 3-6 years old) this system produced a P_aCO_2 of 37 ± 2 torr (range 35-40 torr). In group II (six patients 7-11 years old) this system produced a P_aCO_2 of 28 ± 2 torr (range 26-31torr). In group III (six patients 11-13 years old) a P_aCO_2 of 37 ± 2 was obtained (range 34-40 torr). The MV to FGF ratios were 1.7: 1 in group I, 1.5: 1 in group II and 1.7 in group III. In five patients there was sufficient time to increase the minute ventilation by approximately 33% by increasing the respiratory rate from 15 to 20 breaths/min. This had no significant effect on the P_aCO_2.

Discussion. We employed essentially the same system as Nightingale but were able to use lower fresh gas flows to achieve normocarbia.[2] This may be explained in part of our use of a low ventilation rate which allowed more washout time and less rebreathing of CO_2. Secondly, the slow ventilation rate coupled with the I:E ratio of 1:2 may have resulted in more laminar air flow, thus resulting in a greater percentage of the tidal volume participating in alveolar ventilation. Other authors have shown I:E ratio of 1:2 to be effective in allowing a sufficient expiratory pause for CO_2 washout.[3] The MV to FGF ratios found with this system are somewhat lower than those recommended by other authors[1,2] The range of values for P_aCO_2 utilizing this system is significantly narrower than those reported by Rayburn or Rose and Froese.[1,3] It is concluded that this system is a safe and relatively efficient one to ventilate children during anesthesia under the conditions described in this study.

References.

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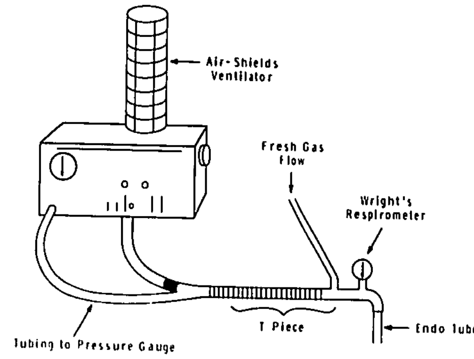

Figure I