Title : Scavenging Pediatric Circuits through an Adult Circle System

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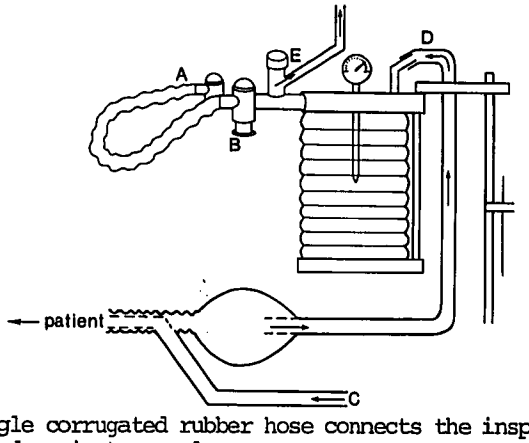
Problems of scavenging waste gases during pediatric anesthesia have demonstrated the need for a simple, effective scavenging method. In this study, a modification of the Albert technique[1] for scavenging pediatric circuits through an existing circle absorption system was evaluated along with a currently available scavenging device during N_2O administration. The Albert technique employs the scavenging system of an adult circle absorber and requires no additional parts.

Methods. The Albert modification is illustrated in the figure



A) A single corrugated rubber hose connects the inspiratory and expiratory valve
B) The reservoir bag connector of the circle absorber is capped
C) The fresh gas flows from the outlet of the anesthesia machine to the T-piece
D) Gases from the reservoir bag of the pediatric system are directed to the gas inlet of the circle absorption system
E) Adjustment of the overflow pop-off valve of the circle system regulates the flow of gas which is directed to the scavenging system of the circle absorber.

Using an infrared spectrophotometer (Foregger 410 N_2O Analyzer) air was sampled continuously at the exhaust grille of an operating room in which the exchange rate was 10 turnovers per hour. Time-weighted average concentrations in parts per million (ppm) were calculated every minute using a multimeter-microprocessor system (Calcumeter 4100 and Data Logging Printer) according to the method described by McGill.[2] Two experimental situations were studied:

A) A leak-free adult disposable rebreathing circuit was attached to a leak-free adult circle absorption system to serve as a control for the existing scavenging system (Foregger Scaveng-OR). Four systems were compared to the control: I. A leak-free Jackson-Rees (JR) connected to the leak-free adult circle

II. A leak-free JR connected to the Ohio scavenging valve (OV) (#207-8114-800) which was connected directly to the scavenging system without passing through adult circle

III. A leak-free Bain Apparatus (BA) connected to the adult circle

IV. A leak-free BA connected to the Ohio valve. The test system consisted of a 2-liter bag (model lung) with an airway pressure gauge attached to the mask adaptor of the study circuits. A 5-liter flow of N_2O: O_2 (3:2) was used in all studies. A distending pressure of 20 Torr was maintained in the circuit for the first 30 minute study period and 10 torr, for the second 30 minutes.

B) Using a modification of the Albert system, N_2O levels from 1 leak-free JR attached to 8 different adult circle systems currently in use in our operating rooms were compared to the control.

Results. A) The average concentration of N_2O spilling from the control and 4 different systems is shown in the table

N_2O concentration (ppm) in 4 different systems and the control (Mean±SE)

Time (min)	System I: JR+CIR	System II: JR+OV	System III: BA+CIR	System IV: BA+OV	CONTROL
0 -10	4.7±0.6	1.6±0.2	18.6±2.3	11.1±1.8	3.5±0.6
11-20	6.8±0.1	1.8±0.1	24.3±0.6	14.9±1.4	5.0±0.3
21-30	8.0±0.2	1.9±0.1	26.5±0.6	17.9±1.1	5.2±0.2
31-40	4.8±0.5	1.0±0.1	18.6±1.5	13.1±1.3	4.6±0.4
41-50	3.3±0.3	0.6±0.1	13.0±1.0	7.7±0.5	3.9±0.6
51-60	3.3±0.1	0.4±0.1	14.7±1.1	6.6±0.3	3.5±0.5

All levels were below NIOSH standards (25ppm) except for one study period in which BA circuit was connected to the adult circle. Gradually the level returned to an acceptable concentration when the inflating bag pressure was reduced to 10 torr. The level of leakage of N_2O was higher in all systems during the first test period compared to the second test period ($p < 0.05$). In all conditions studied the level of N_2O from the BA system exceeded that of the others.

B) When one JR circuit was connected to any of 8 different circle systems, in only one condition was an average concentration over 25ppm reached.

Discussion. Under conditions studied the modified Albert scavenging system has allowed an average concentration of N_2O below NIOSH standards. Whenever an anesthesia machine and an adult circle scavenger are available, inhalation anesthesia can be provided to pediatric patients using standard circuits. Assembly is simple and does not require addition of any new parts or devices. The reservoir bag pressure can be regulated easily by means of the pop-off valve. Airway pressure can be monitored during assisted or controlled ventilation using the pressure guage of the circle system. Although the conditions of this study have only simulated daily practice, the clinical application of this system has been confirmed in our institution.

References.

1. Albert CA, Kwan A, Kim C, et al: A waste gas scavenging valve for pediatric systems. Anesth Analg 56:291, 1977
2. McGill WA, Rivera O: Time weighted averaging for nitrous oxide. An automated method. Anesthesiology (in press)