Title: EVALUATION OF PERSONAL DOSIMETERS TO MEASURE N_2O EXPOSURE, WHEN USING DIFFERENT GAS FLOWS

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Introduction. Monitoring of waste anesthetics in all operating room (OR) suites has been recommended by NIOSH.[1] However, surveillance has been usually taken by isolated, random, seasonal, and spotty sampling at different sites in the operating room. This practice may not necessarily reflect the real exposure of O.R. personnel to hazardous waste gases.[2] To determine the real rate of exposure to nitrous oxide, personal dosimeters for N_2O were worn by anesthesia and nursing personnel during anesthetic procedures, using three different sets of anesthetic total gas flow rates (TGF) and a control group.

Methods. All studies were conducted in 19 operating rooms of about the same size, having the same temperature and 15 room air changes per hour between 7:00 and 15:00 hrs. Observations were made under four different sets of circumstances, as follows:

Group I (high flow) using $N_2O{:}O_2$ at 3:2 l/min, with a CO_2 absorber.
Group II (low flow) using $>$ 500 ml/min N_2O in O_2, with a CO_2 absorber.
Group III using a non-rebreathing technique for pediatric patients $N_2O{:}O_2$ at 3:2 l/min.
Group IV (control) in the cystoscopy OR, using topical anesthesia only.

All anesthetic apparatus had a scavenging suction system running at 45 to 50 mmHG of negative pressure with an adjustment valve. Anesthetic machines and delivery hoses were tested for leaks. Pen-size dosimeters (NITROX TNI, R.S. Landauer, Jr. & Co.) were worn by anesthesiology residents or CRNAs in their shirt pockets. The dosimeters were opened to exposure from the moment the N_2O gas flow was initiated until it was turned off. The precise times of exposure were recorded. The dosimeters were worn for five consecutive working periods, then samples were analyzed by an infrared analyzer by the manufacturer. N_2O and O_2 were administered along with other potent inhalation anesthetics, supplemented by opioids. The total amount was measured as ppm-Hrs. and expressed as time weighted average (T.W.A.) by dividing ppm-Hrs. by total exposure time (Table 1).

Results. The mean T.W.A. in ppm for the four different groups are shown in Table 1. Statistically significant differences were noted in T.W.A. between group I and II ($p < .01$) and group I and III ($p < .01$). No measureable amounts of N_2O were found in group IV (control).

Discussion. Even though any comparison of measured concentrations may involve errors in analytical methodology, TGF, rates of room air exchange and work practices, our results with high flows, indicating a mean T.W.A. of 58 ppm are comparable with those noted by Piziali, et al[3], using 3 l/min. of N_2O TGF. The lowest T.W.A.'s were found in dosimeter worn by personnel using TGF of N_2O lower than 500 ml/min., but when higher TGF were used either in a semi-open circuit ($p < .01$) or in a non-rebreathing system ($p < .01$), levels of N_2O exceeded those recommended as safe by NIOSH. These latter results are similar to those found by Virtue, et al[4], measuring N_2O by direct infrared methodology after bag collection. While passage dosimeters utilize the principle of molecular diffusion with a molecular sieve as the collection medium, it appears to be reliable, less expensive, educational to users and less disturbing to other O.R. personnel.

TABLE 1.

GAS FLOWS	TOTAL HOURS	MEAN T.W.A.	TOTAL PPM-HRS.
High Flow (N=8)	88.43	58	5133
Low Flow (N=7)	74.08	4.2	314
Non-rebreathing (N=4)	19.25	202	3892
Control (N=4)	86.2	M	M

References.
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