Title: ADMINISTRATION OF NITROUS OXIDE TO PEDIATRIC PATIENTS PROVIDES ANALGESIA FOR VENOUS CANNULATION

Authors: JM Henderson MD FRCPC, DG Spence MD FRCPC, LM Komocar RN, GE Bonn MD FRCSC, RJ Stenstrom MSc

Affiliation: Department of Anesthesia, Children's Hospital of Eastern Ontario, Ottawa, Ontario

**Introduction.** Venous cannulation performed before the induction of anesthesia can be a painful and frightening experience for children. In order to determine whether analgesia and reduction in anxiety could be provided for awake pediatric patients nitrous oxide ($N_2O$), 50 or 70% in oxygen ($O_2$), was administered via mask before and during venous cannulation.

**Methods.** Approval by the Hospital Research Committee and informed consent were obtained to study 118 patients 5 months to 18 years of age, scheduled for elective surgery. All patients were ASA PS I and unpremedicated. In the operating room patients were randomly assigned to receive one of four treatments for 3 min prior to venous cannulation, 50% $N_2O$ in $O_2$, 70% $N_2O$ in $O_2$, 100% $O_2$, or no mask, *ie.*, no gas. The gas was administered via a soft, clear anesthesia mask gently but firmly applied to the face. An anesthesia machine used only for administration of $O_2$ and $N_2O$ delivered the gas via a Bain circuit. Gas flows were 300 cc/kg. Venous cannulation, using a 22 gauge catheter, was performed by the same person throughout the study.

An observer, blinded to the treatment (except the no mask group), recorded the following:

History of previous surgery; attendance at preoperative class; history of behavioral problems, *eg.*, hyperactivity, extreme fear of needles, *etc.*;

Behavior during placement of facemask and venous cannulation;

Pain score[1] during venous cannulation (score ≤ 6 indicates absence of pain behavior);

Heart rate, blood pressure (Dinamap™), and oxygen saturation (Nellcor™), measured after monitors attached (baseline), 3 min later, *ie.*, after administration of gas and just prior to venipuncture, and immediately following venous cannulation;

Complications and side effects.

Data are reported as incidence (%) or mean ± SD. Data were analysed using Chi-square analysis, or analysis of variance and the Newman-Keuls test. $P < 0.05$ was considered statistically significant.

**Results.** Children who received $N_2O$ were more likely to be relaxed and have lower pain scores during venous cannulation (table). After 3 min of administration of 70% $N_2O$ in $O_2$, heart rate and systolic blood pressure decreased and did not change following venous cannulation. Systolic blood pressure also decreased after administration of 50% $N_2O$ in $O_2$. In the group given 100% $O_2$, heart rate increased following venous cannulation. Oxygen saturation did not drop below 95% at any time. Side effects were seen in the group who received 70% $N_2O$ in $O_2$: excitement was noted in 7 children, dysphoria in 2, and 1 experienced nausea but did not vomit. None of these children reacted to venipuncture. There was no difference between groups with respect to history of previous surgery, attendance at the preoperative classes or history of behavioral problems.

Table. Comparison of patients receiving no mask, 100% $O_2$, 50% $N_2O$ in $O_2$, or 70% $N_2O$ in $O_2$. Data reported as mean ± SD or incidence (%).

| | No mask | 100% $O_2$ | 50% $N_2O$ | 70% $N_2O$ |
|---|---|---|---|---|
| N | 25 | 38 | 23 | 32 |
| Age (years) | 7.7±5.5 | 6.5±5.1 | 5.2±3.8 | 6.0±3.7 |
| Weight (kg) | 29.6±18.8 | 28.8±20.1 | 21.8±11.9 | 24.4±14.3 |
| Accepts mask | n/a | 71 | 70 | 63 |
| Relaxed during venipuncture | 28 | 29 | 70* | 88* |
| Pain score ≤ 6 | 20 | 16 | 61* | 81* |
| Heart rate: | | | | |
| Baseline | 106±37 | 111±32 | 102±21 | 114±34 |
| Pre-venipuncture | 106±34 | 107±38 | 95±22 | 97±23† |
| Post-venipuncture | 111±34 | 117±37§ | 107±34 | 100±26† |
| Systolic BP: | | | | |
| Baseline | 121±20 | 123±15 | 114±18 | 122±14 |
| Pre-venipuncture | 118±16 | 122±18 | 103±18† | 110±12† |
| Post-venipuncture | 123±15 | 124±19 | 109±16 | 110±15† |
| Side effects | 0 | 0 | 0 | 31‡ |

* Different from both no mask and 100%.
† Different from baseline.
§ Different from pre-venipuncture.
‡ Different from all groups.

**Discussion.** The administration of 50 or 70% $N_2O$ in $O_2$ to children is a useful and effective method of decreasing the pain and anxiety associated with venous cannulation. It is readily available in the operating room and easy to administer and should help the anesthesiologist in the quest to provide pediatric patients a pleasant and pain-free operative course.

**References.**

1. McGrath PJ, Johnson G, Goodman JT, Schillinger J, Dunn J, Chapman J: CHEOPS: A behavioral scale for rating postoperative pain in children, Advances in Pain Research and Therapy, Vol. 9, Edited by Fields HL. New York, Raven Press, 1985, pp 395-402