Arterial Blood Oxygenation During Thoracotomy Using 70 Per Cent Nitrous Oxide in Oxygen

Azmy R. Boutros, M.D.,* and Mary R. Weisel, M.D.†

Two ventilation patterns known to minimize physiological shunting were used during thoracotomy performed in the lateral decubitus with 70 per cent N₂O in O₂ and d-tubocurarine. Tidal volumes twice the Radford prediction, at 14 inflations per minute were used on 40 patients. Half the patients also received sustained hyperinflation for 10 seconds every 10 minutes during the operation. Average PaO₂ observed with the chest open was significantly higher (P < 0.01) than corresponding preoperative values in both groups. However, 5 patients receiving large tidal volumes without sustained hyperinflation had a PaO₂ less than 60 mm. of mercury, but only one PaO₂ less than 60 mm. of mercury was observed in the patients receiving sustained hyperinflation. PaCO₂ and pH values reflected effects of hyperventilation. Blood pressures were stable during the procedure.

A recent study by Hallowell et al.¹ demonstrated that use of 50 per cent nitrous oxide in oxygen with assisted or controlled ventilation in anesthesia for closed mitral valvulotomy occasionally resulted in critically low oxygen tensions while the chest was open. They attributed this to "physiological shunting" in the lungs and concluded that the use of nitrous oxide for thoracic surgery in patients with cardiopulmonary disease was probably contra-indicated.

There is ample evidence to indicate that the degree of physiological shunting and venous admixture during anesthesia can be reduced by the use of large tidal volumes or by occasional hyperinflation.²,³

The purpose of this study was to investigate arterial oxygenation during thoracotomy performed on patients anesthetized with 70 per cent N₂O but using ventilation patterns likely to reduce physiological shunting. This was accomplished by use of: (1) tidal volumes large enough to maintain an average PaCO₂ of 25 mm. of mercury; (2) large tidal volumes plus repeated sustained hyperinflation.

Method

Forty consecutive patients scheduled for elective thoracotomy for various reasons, were studied. Arterial oxygen and carbon dioxide tensions and pH, vital capacity, one-second forced expiratory volume (FEV₁%,) and maximum expiratory flow rate (MEFR) were determined on all patients the day before operation.

On the day of operation, following preanesthetic medication with morphine (average dose 8.9 mg.) and scopolamine (average dose 0.35 mg.), brachial or radial arterial cannulation was performed and a blood sample was taken 15 to 30 minutes later. Anesthesia was then induced with thiopental (average dose 172.8 mg.) and d-tubocurarine (average dose 29.4 mg.). After insertion of a cuffed endotracheal tube, anesthesia was maintained with nitrous oxide-oxygen 7:3 liters/minute via a circle system with carbon dioxide absorption and repeated doses of d-tubocurarine. Inspired oxygen concentration was measured with a paramagnetic oxygen analyzer and maintained at 30 per cent. Manual ventilation was performed utilizing a Roswell Park Ventimeter (Air Shields, Inc.) at the rate of 14 per minute and a tidal volume equal to approximately twice the value predicted from the Radford Nomogram.⁴ Tidal volumes ranged from 500 ml. (for a female weighing 80 pounds) to 1,300 ml. (for a male weighing 250 pounds).

Esophageal temperature was measured by a Tele-Thermometer (Yellow Springs Instrument Company, Inc.). In the first 20 patients (Group 1) periodic hyperinflation of the lungs

---

* Associate Professor, Department of Anesthesia, University of Iowa College of Medicine, Iowa City, Iowa.
† Assistant Professor.
Accepted for publication January 23, 1967.