CURRENT COMMENT

STUART C. CULLEN, *Editor*

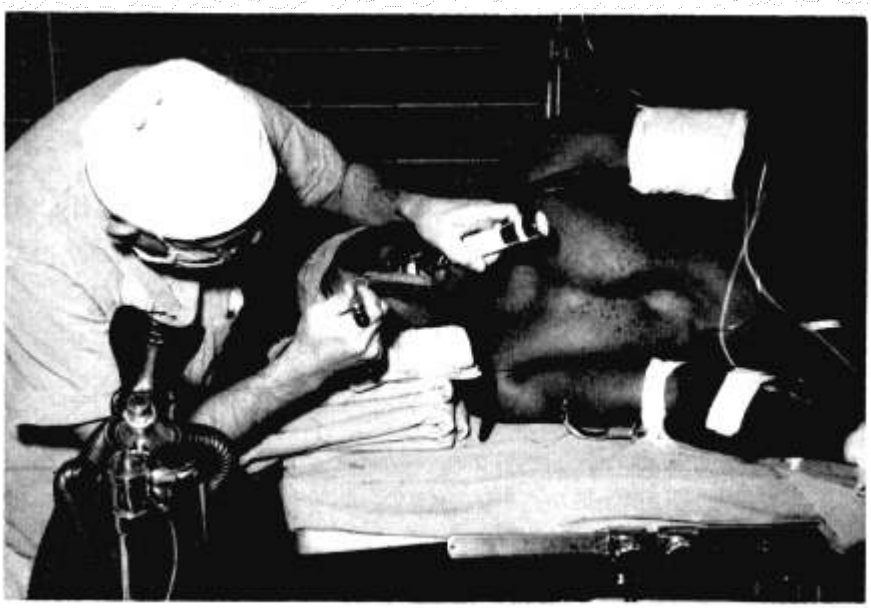
OROTRACHEAL INTUBATION IN THE LATERAL POSITION

Drs. Anibal Sanchez-Salazar and Charles L. Burstein of New York City describe the technique of orotracheal intubation in the patient in the lateral position. Although this is not a new procedure, it is seldom practiced. They believe there is almost no limitation in extension or flexion of neck positions at the time of laryngoscopy in this position; therefore, intubation can be as easy in this position as it is with the patient supine.

They report that in the last six months all patients in Bellevue Hospital requiring surgery in the lateral position with an endotracheal airway have been intubated in the lateral position. None have had any complications concerned with the technique *per se*.

Certain preliminaries are done while the patient is still supine. The blood pressure cuff is placed on the arm that will be up, and the intravenous infusion is started in the forearm that will be down. The patient is turned then onto the desired side with the inferior leg flexed and a pillow placed between the knees. Wide tape is applied from side to side of the table and over the greater trochanter. A suitable pillow is placed under the patient's head, high enough to avoid any lateral flexion of the neck. The patient's blood pressure is recorded again before induction of anesthesia.

It is easier to perform induction and intubation with the anesthesiologist remaining in a standing position and the table raised until the patient's head reaches the height of the anesthesiologist's waist. It is helpful to rotate the patient's head to 35–45 degrees and to maintain this position by placing a small folded sheet under the cheek (as illustrated). In this lateral position the patient's head can be flexed, hyperextended, pushed forward or backward with ease. The vocal cords are sprayed with a suitable topical anesthetic. At this time, one can observe the anatomical conformation of



Position of patient prior to intubation in the lateral position.

the pharynx and larynx. It is recommended that muscle relaxants be omitted until this technique of intubation is mastered.

It is easier to intubate the patient when he is lying on the right side if the laryngoscope is held in the left hand. When the patient is on the right side the tongue deviates to the right. This difficulty may be obviated by introducing the blade close to the right side of the mouth (in this position, actually down) and pushing the tongue to the left (actually up). The inferior arm with the intravenous infusion may rest on an armboard. It is advisable to keep the superior arm from interference during intubation. An assistant can hold the arm and retract the shoulder. After the intubation the upper arm is placed in the desired position.

The advantages of performing orotracheal intubation in the lateral position are: (1) The patient's blood pressure is not altered by positional change. (2) Obese patients are handled and managed easier. (3) It is a procedure for those patients previously placed in lateral position who need an endotracheal airway without delay, or for the rare patient who cannot be placed supine. (4) Being awake and positioned before anesthesia, the patient can notify you of painful or harmful areas between table or table accessories and his body.

THE "TIGHT JAW" IN RESUSCITATION

Drs. Peter Safar and Joseph Redding of Baltimore have some comments on the suggestion that mouth-to-mouth and mouth-to-airway resuscitation might be impossible in an apneic victim whose jaws are tightly clenched and that mouth-to-nose and mouth-to-mask resuscitation would be feasible in such a case.

The coexistence of a "tight jaw" and transient apnea is observed during epileptic seizures. This self-limited condition, however, rarely requires artificial respiration.

Outside the operating rooms anesthesiologists at the Baltimore City Hospitals during the past year ventilated 72 apneic patients, using various techniques of positive pressure inflation. Fifteen of these patients were salvaged. In only one instance was difficulty in opening the mouth encountered.

A 5 year old, apneic, comatose boy with meningitis was brought to the accident room. In spite of a tightly closed mouth the intern adequately ventilated the child by mouth-to-mouth insufflation by blowing between the child's teeth. An oropharyngeal airway was then inserted with only moderate difficulty by prying the mouth open with an index finger behind the posterior molars.

Several rescue workers with many years experience stated that they have never encountered an apneic victim whose mouth they could not pry open.

How dependable is the nasal air passage? In our experiments on curarized volunteers mouth-to-nose breathing met partial airway obstruction in 50 per cent of the subjects, even with maximal hyperextension of the head and with the mandible displaced forward. In all these subjects mouth-to-mouth breathing produced larger tidal volumes than did mouth-to-nose breathing by the same lay operators.

We found partial or complete obstruction of one or both nasal passages in 25 of 100 conscious normal adults.

In an attempt to evaluate the "tight jaw" we produced apnea in 2 adult volunteers for 3 hours each by thiopental-meperidine-controlled respirations, *without the use of muscle relaxants.* (Although the jaws were "tight" it proved difficult with this technique to produce completely clenched jaws and apnea at the same time.) Tidal volumes were recorded with a calibrated pneumograph. Successful performance was considered to be the production in less than 60 seconds of at least 2 tidal volumes (a) over 500 ml. and (b) over 1,000 ml. Firemen, previously not instructed in exhaled air resuscitation, were chosen as operators. Eighteen of them performed mouth-to-airway and mouth-to-mask breathing, and 12 others performed mouth-to-nose and mouth-to-mouth breathing immediately after an instruction and demonstration. With all methods the jaw was held at its angles with both hands. In addition, the rescuer's thumb retracted the lower lip during mouth-to-mouth breathing (mouth-to-mouth method 2, J. A. M. A. 166:

UNTRAINED LAYMEN (FIREFIGHTERS) PERFORMING EXHALED AIR RESUSCITATION ON 2 "TIGHT-JAW" APNEIC VOLUNTEERS

Method	Number of Operators	Number of Operators Successful With Tidal Volumes Over	
		500 ml.	1,000 ml.
Mouth-to-mouth*	12	12(100%)	9(75%)
Mouth-to-nose	12	10(83%)§	9(75%)
Mouth-to-airway†	18	18(100%)	12(67%)
Mouth-to-mask‡	18	11(61%)	6(33%)

* Mandible held at angles, lower lip retracted with thumbs.

† Plastic mouth-to-mouth airway with cupped flange.

‡ Plastic pocket-sized mask.

§ In 7 of the 10 successful performances the mouth had to be opened for expiration because of expiratory nasal obstruction.

335, 1958) and closed the mouth during mouth-to-nose breathing. The selection of operators and the sequence of performance of the techniques was randomized. Demonstration and instruction were comparable, stressing (1) extreme tilting back of the head and raising forward of the mandible, (2) prevention of air leakage, and (3) forceful blowing.

The results are shown in the table. There were no complete failures with mouth-to-mouth and mouth-to-airway breathing. When the jaws were not separated, tidal volumes of over 1 liter could be produced with mouth-to-mouth breathing in both subjects by blowing through their teeth. During the apneic period the teeth could be separated at least 2 cm. and all 18 rescuers could insert the artificial oropharyngeal airway. With mouth-to-airway breathing tilting back of the victim's head was sufficient for airway patency and forward displacement of the mandible was not essential.

The failures with mouth-to-nose and mouth-to-mask breathing were mainly due to a higher incidence of partial expiratory obstruction, resulting in an increase of the resting lung volume. Failures with mouth-to-mask breathing were also due to leakage between face and mask. The expiratory obstruction noted with the use of the nasal air passage possibly is caused by a valve-like behavior of the soft palate or by the fact that a greater pressure gradient existed during the inflation phase than during the passive exhalation phase.

Our observations suggest (1) that spasm of the jaw muscles is rarely encountered in an apneic victim and (2) that even in such a rare instance laymen are more often successful with resuscitation through the victim's oral air passage than through the nasal air passage.

Expert anesthesiologists could adequately ventilate our subjects with *any* exhaled air method. Lay rescuers, however, were more successful with one method than with another. A particular technique should therefore be considered superior to another for universal use only if inexperienced lay rescuers could produce with it superior ventilation in unconscious apneic subjects in a statistically valid comparison.

Supported by the Department of the Army, Contract No. DA-49-007-MD-858.

SIMPLE METHOD OF DETERMINING CO_2 CONTENT OF ALVEOLAR AIR

Drs. Robert H. Smith and Perry P. Volpitto of Augusta, Georgia, report a rapid, reliable and simple means of determining alveolar CO_2 during anesthesia. The method is based on the rapid barium hydroxide reaction with CO_2 to form barium carbonate. The patient's alveolar CO_2, in volumes per cent, is compared with the CO_2 content of 5 per cent carbogen. They state that it is a quick way of determining whether the patient's alveolar CO_2 is above, below, or approximately 5 volumes per cent.

Equipment. 50 cc. syringes, 20 cc. syringes, 10 cc. test tubes with caps, needles, long 10 F suction catheters and 3-way stopcocks are needed. The stopcocks are the type with a male and a female fitting on the cross T, and a female fitting on the side arm.

Material. (1) 5 per cent–95 per cent CO_2 in O_2 (carbogen). (2) Filtered, saturated barium hydroxide solution (about 5 per cent). (3) Gum ghatti, as commercial 3% solution, or as "beads" to make 3% solution in distilled water. (4) Distilled water for injection, in ampules.

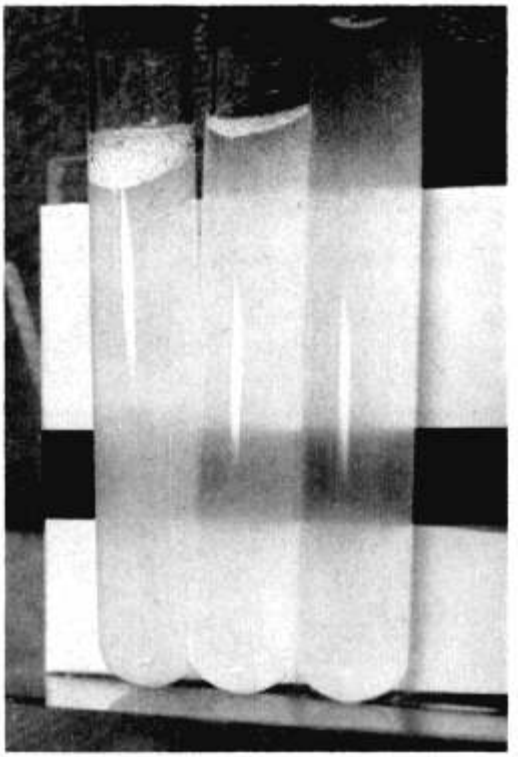
Method. STEP 1: MAKING THE STANDARD FOR COMPARISON. A 50 cc. syringe is filled, via the 3-way stopcock, with 5 per cent carbogen. The test volume is 25 cc. Through the side arm of the 3-way stopcock there is introduced a 12 cc. mixture comprising 2 cc. 3 per cent gum ghatti solu-

tion, 3 cc. saturated $Ba(OH)_2$ solution, and 7 cc. distilled water. The gas and the liquid are shaken together for 2 minutes. Ten cubic centimeters of the resultant suspension are injected into a 10 cc. test tube which is immediately capped.

STEP 2: MAKING THE SAMPLE TEST. A 10 F 22-inch suction catheter is attached to the male fitting of the 3-way stopcock which is fixed to a 50 cc. syringe. The catheter is put down the patient's endotracheal tube as far as it will go. At the end of a normal expiration the chest is pressed down firmly. The 50 cc. syringe is aspirated full of alveolar gas, emptied through the side arm, and refilled. This requires 15 seconds.

The test volume is 25 cc. The 12 cc. of reagent mixture described above are added to the 25 cc. gas sample in the 50 cc. syringe. The gas and liquid are shaken together for 2 minutes, then 10 cc. of the resultant suspension are injected into a test tube which is immediately capped.

STEP 3: COMPARING THE TEST WITH THE STANDARD. The two test tubes are compared in reflected light against a "black-line card." The suspended precipitate blocks light transmission in proportion to the amount of particulate matter present. This method, at this dilution, makes 1½ volumes per cent of CO_2 difference clearly detectable. A 1 per cent difference is not easily discerned. Concentrations of 3½, 5 and 6½ per cent can be quickly differentiated. Above 8 per cent, at this dilution, differences in CO_2 content cannot be detected; all suspensions are too dense to permit the passage of light.



Rapid determination of carbon dioxide content of alveolar air with barium hydroxide. Left to right: 6½, 5 and 3 per cent carbon dioxide.

Comment. (1) The test gives no precipitate with ether, cyclopropane, nitrous oxide, Fluothane, ethylene, or Trilene, plus oxygen. The only source of precipitate is CO_2. (2) The gum ghatti coats each particle as formed and prevents precipitation and flocculation. The test tubes can be shaken, and, after all air bubbles have risen, the test is informative up to 24 hours after it is made. (3) The test requires about 3 minutes of time. (4) The $Ba(OH)_2$ solution reagent must be kept free of air to avoid CO_2 contamination. Although the 0.04 per cent CO_2 in air is not a detectable error in this simple test, $Ba(OH)_2$ will absorb whatever CO_2 reaches it, and, with time, show a precipitate, unless the solution is closely capped. The gum ghatti solution develops a fungus-like growth in about 3 weeks, and must be replaced. The commercial form is much more resistant to this nuisance. (5) A "black-line-card" is made by drawing a ¾ inch-wide black band to bisect the width of a 4 × 6 inch white card. The band is a "flat" black, best produced by drawing ink. (6) One who wishes to use this method may find the following information useful in making practice "standards" and "tests:"

(a) The amount of liquid reagent is a constant volume: 12 cc. The test volume of a gas is a constant: 25 cc.
(b) 15 cc. 5 per cent carbogen has a CO_2 content equal to 25 cc. of 3 per cent CO_2.
(c) 20 cc. 5 per cent carbogen has a CO_2 content equal to 25 cc. of 4 per cent CO_2.
(d) 30 cc. 5 per cent carbogen has a CO_2 content equal to 25 cc. of 6 per cent CO_2.
(e) 35 cc. 5 per cent carbogen has a CO_2 content equal to 25 cc. of 7 per cent CO_2.

(7) It is important, in adding the liquid to the gas, to avoid losing gas. When the liquid is being forced into the 50 cc. syringe there must be no obstacle to the free movement of the plunger of the receiving syringe.

Drs. Smith and Volpitto wish to thank Dr. W. L. Shepeard, Professor of Pathology in charge of Clinical Pathology, Medical College of Georgia, for his help with this problem.

FINGER BLOCK FOR LOCAL VASODILATATION

Dr. Douglas Eastwood of Charlottesville, Virginia, finds that injection of 2 cc. of 2 per cent lidocaine at the base of a finger in close proximity to the digital arteries provides vasodilatation of the finger vessels. This sympathetic block has been used to overcome vascular spasm in the finger associated with shock states, during hypothermia, and during or following extracorporeal circulation. A comparison of the finger thus blocked with the adjacent finger permits one to distinguish cyanosis on the basis of stagnation in peripheral vessels from cyanosis due to anoxic anoxia. A temporary effect can be obtained by rigorous rubbing of the finger tip to squeeze out the desaturated blood and to produce some local vasodilatation. In addition to observing loss of cyanosis which can be a useful clinical aid, the finger block has been used to increase pulsations in the finger tip so that a photo-electric pulse detector becomes more effective.

A sympathetic block at the stellate ganglion has been used for this same purpose and to permit auscultation of the blood pressure in states of intense vascular spasm following extracorporeal circulation. One instance of asystole necessitating a short period of artificial circulation and other instances of temporary partial heart block have led to substitution of the finger block technique for the stellate ganglion block.

GADGETS

Use of a Photo-Sphygmometer in Indirect Blood Pressure Measurements

Mr. Robert E. Robinson III and Dr. Douglas W. Eastwood present a method for the indirect measurement of blood pressure applicable where conventional techniques are inadequate. The method utilizes a pressure cuff and an electronic pulse detection and indication system (fig. 1).

With each cardiac cycle, the volume of blood in a vessel network fluctuates. The change is slight; however, it may be detected by observing changes in the transmittance of a beam of light passing through the network. Using a sensitive crystal photocell, a low intensity light source, and an amplifier, fluctuations can be picked up from any mass of tissue which has a vascular supply and through which the light can be transmitted. The nail bed is ideally suited as it is highly vascular and light readily passes through it and the remainder of the finger tip.

The fluctuations may be monitored with a small transistorized unit in which the signal is amplified and then indicated by deflections on a ballistic meter or by the presence of an audio tone. Also, they may be displayed on a graphic recorder or an oscilloscope.

To use the system in blood pressure determinations, the photocell lamp assembly is clipped on a finger and the light intensity and amplifier gain are adjusted until the fluctuations are observed. A blood pressure cuff placed around the arm is inflated above the point at which they disappear. Pressure is slowly lowered until the initial fluctuations are observed; at this point, cuff pressure will

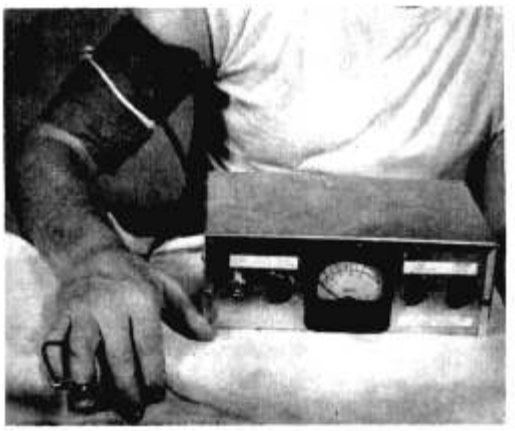


FIG. 1. Application of the Photo-Sphygmometer to the measurement of blood pressure, showing blood pressure cuff and photocell in place. *Controls on the monitor from left to right:* power on-off, tone level, signal indicating meter, light intensity, and sensitivity.