CURRENT COMMENT AND CASE REPORTS

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A NEW USE FOR PROMETHAZINE HYDROCHLORIDE

Drs. Patricia Gibney and Stephen LoVerme of East Orange, New Jersey, present a case report to suggest a technique for administration of promethazine as an adjuvant to anesthesia. To their knowledge, this is the first time the drug has been employed in this manner.

A 41 year old man of medium build was admitted to the hospital on December 30, 1956, suffering from second and third degree burns of hands, lower extremities, genitalia, and the lower abdominal area. He also had evidence of smoke poisoning. This man was a known severe alcoholic with a history of frequent attacks of delerium tremens, as well as a paraldehyde addict. His general condition on admission was poor, although blood pressure was 116/70 and hemoglobin was 12.9 Gm. His first surgical procedure, a debridement of the burns, was performed on December 31. The premedication was pentobarbital, 100 mg., meperidine, 100 mg., and atropine, 0.6 mg. For the next 10 procedures, the pentobarbital was increased to 200 mg. while the rest of the premedication remained the same. The anesthesia for the first operation consisted of thiopental sodium, 0.5 per cent infusion drip for induction, followed by cyclopropane for maintenance. The patient did relatively well during the operation which lasted 1 hour 40 minutes. Four days later the same procedure was performed with the same anesthesia. Within the next three days, the patient developed a bilateral pneumonitis. They were anxious to avoid an inhalation anesthetic because of the pneumonitis and consequently did the third debridement with intravenous meperidine drip (a total of 250 mg. given in one hour) with poor results. The patient was markedly uncomfortable throughout the procedure and little was accomplished. For the next six operations, a combination of intravenous meperidine and promethazine hydrochloride by the intravenous drip technique was used. Promethazine hydrochloride, 250 mg., was added to 500 cc. of 5 per cent dextrose in water which was then given as an infusion and accompanied by divided doses of meperidine as necessary. The results were excellent, the patient was entirely comfortable, and extensive debridement was accomplished. The chart below summarizes doses of drugs and duration of procedures.

Date of Operation	Promethazine (mg.)	Meperidine (mg.)	Duration of Operation (minutes)
1-8-57	250	75	45
1-9-57	275	100	55
1-11-57	215	75	65
1-14-57	275	100	75
1-18-57	180	75	55
1-21-57	200	100	32

In each case, the patient was drowsy and apparently analgesic, but did respond to questions throughout the procedure. He was fully reactive and well oriented at the end of each administration of this drug combination. There were no untoward sequelae.

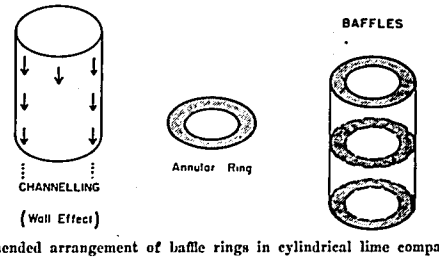
Following the results with this patient, they have found other uses for this particular method of administration. Patients requiring plastic surgery seem to be particularly good candidates for this method. Also, many paraplegics who have little sensation, but who still seem to require a general anesthesia for procedures such as ischiectomy, are now being given a promethazine infusion with successful results.

Drs. Gibney and LoVerme have also used this method on 10 patients on the general surgery service, who had operative procedures (all major surgery) performed under local and/or block anesthesia. All these patients were considerably more comfortable than others who had previously been operated on with local anesthesia and heavy preoperative medication.

CHANNELING AND OVERPACKING IN CARBON DIOXIDE ABSORBERS

Dr. James O. Elam of Buffalo, New York, believes that the recent packaging of the soda limes and Baralyme in smaller paper containers results in more convenient servicing of absorbers and probably a more uniform moisture composition of lime from day to day. He also believes, however, that with the more flexible containers there is a marked tendency for the granules to pulverize, apparently during shipping and handling. Excessive powder ("fines") in the absorbent may produce severe channeling in any absorber. Moreover, careful packing technique may actually aggravate such channeling by further increasing the powdered fraction and accentuating its nonuniform distribution in the absorbent bed.

The channeling of expired air along preferential paths of lesser resistance through the absorbent bed decreases the efficiency and reliability of carbon dioxide absorption. Usually, these preferential paths are along the compartment walls where granules cannot fit snugly against plane surfaces. The recommended packing technique for charging one-half of the Roswell Park Absorber consists of adding 1 to 2-inch increments



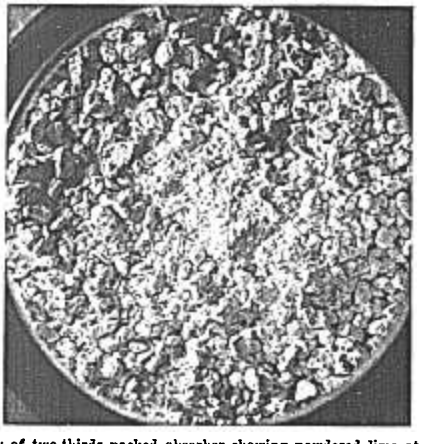
Recommended arrangement of baffle rings in cylindrical lime compartment.

of lime at a time and tapping at the side of the absorber as it is rotated. A uniform distribution of expired air through the absorbent bed is effected by 3 annular baffles placed at the tip, center, and bottom of the cylindrical lime compartment as illustrated. During the many trials in which the optimal dimensions for these baffles were established, we frequently observed anomalous exhaustion patterns in the absorbent bed when lime containing "fines" from the bottom of the large can was used. These channeling effects were consistently related to the distribution of "fines" in the lime.

An example of selective distribution of powdered lime which produces considerable channeling (and frequently hard "caking" as well) is also illustrated. In this 2-chamber canister (Jumbo—not the Roswell Park absorber design), there is no distributor space at the top of the lime mass and the top and bottom baffles are omitted. The result was pronounced channeling along the outer walls when optimal granular lime, 4 to 8 mesh (without "fines") was used. Moreover, when this canister was packed with fresh lime taken from a paper package, the central distribution of the powdered lime produced an even greater shunting of airflow along the unbaffled walls. A concentric zone of used lime about an inch thick around the periphery was noted. A large dome-shaped

mass of unused lime in the center was by-passed. The resistance to breathing through the absorber further increased as water released by the chemical reaction gravitated to the bottom half of this absorber which does not provide a water trap. These effects produced poor carbon dioxide absorption performance, an increased breathing resistance, and the formation of dense "caking" as moisture accumulated.

Another complication related to packing the Roswell Park absorber concerns accumulations of hydroxide in the water trap or lower compartment of the absorber. Experience has shown that the water collected in the trap is not alkaline provided this compartment was free of absorbent dust at the time of servicing. However, "fines" may be deposited in the trap at the time of servicing. This may result in subsequent formation of solutions of sodium hydroxide sufficiently strong to burn the skin. Pre-



Top view of two-thirds packed absorber showing powdered lime at center.

cautions to prevent this difficulty include: (1) wiping the lid of the RPA free of absorbent "fines" at the time of servicing, (2) omitting unnecessary jarring of the absorber after dry fresh absorbent is packed in the lower compartment, and (3) emptying and washing the bag between cases if it is used in the dependent position so as to collect water from the absorber.

Improved absorber design cannot solve all the problems incident to carbon dioxide absorption. Reasonable attention to packing of lime after elimination of powder by sifting is essential to obtaining efficient and reliable performance in any absorber. These precautions become more important in a cylindrical absorber without baffles, distributor space, or water trap.

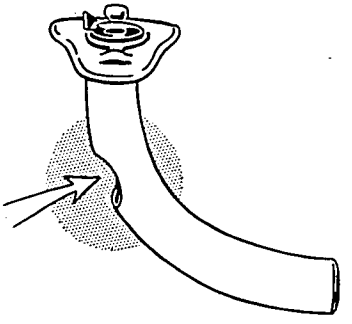
HYPOTENSION AND INTRAVENOUS ADMINISTRATION OF *d*-TUBOCURARINE

Dr. Edmond Eger of Iowa City, Iowa, was intrigued by the debate about hypotension following the intravenous administration of *d*-tubocurarine. He performed the following limited experiment to eliminate, as far as possible, the effect of increased

muscular relaxation, change in depth of anesthesia, or change in ventilation on blood pressure, or combinations of these factors, following the intravenous injection of *d*-tubocurarine. Of the 6 patients used in the study, one received nothing, one atropine, and 4 scopolamine for premedication. Anesthesia was induced with nitrous oxide and oxygen in 2 patients and with thiopental sodium (average 200 mg.) in the remaining 4. Anesthesia was maintained with 70 per cent nitrous oxide and 30 per cent oxygen. Immobility and relaxation were provided by a succinylcholine drip. In addition, in two cases Arfonad was added via a separate drip. Ventilation was performed through a cuffed endotracheal catheter by a Jefferson ventilator whose pressure settings (usually +10 and −10) were unchanged during any particular procedure. At the suggestion of Dr. John Severinghaus, all patients were put in reverse Trendelenberg position, varying from 8 to 20 degrees. After the systolic blood pressure had not varied more than 10 mm. of mercury for over ten minutes, and after the succinylcholine and Arfonad drips were running at a constant rate for at least fifteen minutes, *d*-tubocurarine in doses ranging from 21 to 30 mg. (average 27 mg.) was administered rapidly via a separate vein. The blood pressure was then checked every thirty or sixty seconds for ten minutes and the following was observed: In the 2 patients who received Arfonad, the blood pressure went from a low in the pre-*d*-tubocurarine period of 110/75 and 120/75 to 100/70 and 45/25, respectively, in the postinjection period. In the other 4 cases, the changes were from 185/95 to 170/85, 115/80 to 75/55, 90/60 to 85/60, and 125/80 to 100/80. The blood pressure fall consistently occurred within one to two minutes following the administration of the *d*-tubocurarine and returned to the preinjection level within five to ten minutes. Thus, this would be missed if readings were not taken during the period immediately following the injection. In one case (no Arfonad), succinylcholine, 50 mg., was given intravenously four minutes before the injection of 30 mg. of *d*-tubocurarine. There was no change in the blood pressure following the succinylcholine, but there was a fall (125/80 to 100/80) following the *d*-tubocurarine.

MODIFICATION OF TRACHEOSTOMY TUBE

Dr. Kenneth D. Hall of Bethesda, Maryland, believes that many anesthesiologists have had to crusade for the use of larger tracheostomy tubes in patients. Often adult patients are fitted with a no. 5 or no. 6 tracheostomy tube when these patients could easily tolerate a no. 8 or no. 9. The advantages of the larger tubes are: increased facility of



Modification of tracheostomy tube.

suctioning the tracheobronchial tree, decreased resistance of the airway, and, if resuscitation is necessary, less leakage around the tracheostomy tube. With laminar flow, if the diameter of the tube is doubled, the air flow at a given pressure is increased almost eight times.

There are certain conditions, however, in which a large tracheostomy tube is disadvantageous. One of these is when it is desirable to close off the tracheostomy tube and re-educate the patient to breath through his mouth or nose. In so doing, if the tube is too large, there is not enough room for air to pass around the tube and considerable resistance to breathing is encountered.

In order to overcome this difficulty with a large diameter tracheostomy tube, the following modification was made in a standard tracheostomy tube. A hole was drilled on the convex curvature of the tube in such a position as to allow as straight a flow of air as possible from the lower end of the tube. The hole was placed where it was neither too high to be blocked by the tissues of the neck, nor too low to be blocked by the posterior trachea. It was found by experience that the hole had to be in the upper one-third of the tube. The edges of the hole were carefully polished with fine crocus cloth so that no sharp edges remained. (See illustration.)

With this modified tube it is extremely important that the inner tube be inserted whenever the patient's tracheobronchial tree is to be suctioned, in order to prevent the suction catheter from going through the hole and traumatizing the posterior trachea, and whenever it is necessary to resuscitate the patient, in order to prevent leakage of air out of the hole. Most inner tubes fit snugly so that little air is lost even with this hole.

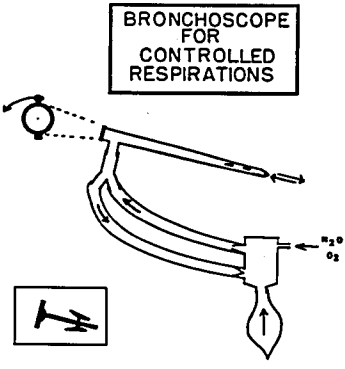
Since increased air resistance is not nearly as important with controlled or assisted respirations as it is with spontaneous respirations, the smaller diameter of the inner tube is not deleterious.

VENTILATING BRONCHOSCOPE

Dr. Peter Safar of Baltimore notes that intermittent positive pressure breathing with a ventilating bronchoscope (Muendnich, K., and Hoflehner, G.: Anaesthetist 2: 121, 1953) is more reliable for producing adequate pulmonary ventilation than a chest (cuirass) respirator. He believes that *all* bronchoscopes, whether they are used in the awake or in the anesthetized patient, should be redesigned to permit intermittent positive pressure breathing (see illustration).

He modified a standard bronchoscope (adult size) as illustrated: A wide metal tube, 2½ cm. long, with a lumen equal to that of the bronchoscope, was attached at a right angle as close as possible to the external end of the scope. This wide side-arm serves for intermittent positive pressure breathing in apneic patients and for oxygen insufflation in patients breathing spontaneously. A removable glass window (obturator) was attached to the external orifice of the bronchoscope to prevent leakage of gas, thus permitting intermittent positive pressure breathing during examination. This window was removed for suction or biopsy. It may or may not be removed for bronchoscopy on the patient breathing spontaneously who is not in need of artificial respiration. A rubber stopper, through which the telescope can be inserted, may be prepared if prevention of gas leakage during the use of the telescope is desired.

For intermittent positive pressure breathing a Y endotracheal connector of an anesthesia circle system (or, for children, a Y or T-tube) is attached to the wide side-arm of the bronchoscope by means of a rubber tubing, which allows for maneuvering of the instrument by the endoscopist. Intermittent positive pressure breathing is performed by manual compression of the breathing bag, as if this were a regular semiclosed circle system with an uncuffed endotracheal tube. (When using the Y or T-tube in children its "tail" may be intermittently occluded for intermittent positive pressure breathing.) The flow rate of gases into the anesthetic system may have to be high, depending on the amount



Ventilating bronchoscope.

of gas leakage between scope and larynx, which in turn depends on the force and rate of inflation required.

The thin oxygen feeding tube leading to the tip of a conventional bronchoscope is unnecessary in the presence of a wide proximal side-arm as described above. The thin oxygen tube narrows the lumen of the bronchoscope. It permits artificial respiration only when bronchoscopy is interrupted, and the external orifice of the bronchoscope is intermittently occluded, while a high flow rate of oxygen is delivered. Bronchoscopy during apnea is undesirable: oxygen insufflation *only* (without ventilation) can prevent hypoxia for several minutes, but not hypercapnea. Hypercapnea may produce harmful

TABLE 1

AVERAGE TIDAL VOLUMES (MILLILITERS) WITH CUIRASS RESPIRATOR AND WITH VENTILATING BRONCHOSCOPE

Patient (Adult) Number	Lungs and Chest	Cuirass Respirator Rate 20 to 26/minute		Bronchoscope for Positive Pressure Breathing Tidal Volume (ml.)
		Pressure in Cuirass Range (mm. Hg)	Tidal Volume (ml.)	
1	Normal	− 30 + 10	640	>1000
2	Normal	− 18 + 5	610	>1000
3	Normal	− 15 + 10	480	>1000
4	Heavy	− 30 + 10	180	>1000
5	Stiff lungs	− 30 + 10	100	>1000
6	Stiff lungs Airway obstruction (secretions)	− 30 + 10	0	>1000

The patients were unconscious (thiopental) and apneic (succinylcholine). Tidal volumes were measured during performance of the cuirass respirator by a Bennett ventilation meter connected to a cuffed endotracheal tube and during intermittent positive pressure breathing with the bronchoscope by a volumetrically calibrated pneumograph.

circulatory effects, particularly in the patient in poor physical status, and limits the time available for examination.

Dr. Safar recommends the ventilating bronchoscope not only for use in bronchoscopy under general anesthesia with the use of muscle relaxants, but also for bronchoscopy under topical anesthesia. Occasionally he found intermittent positive pressure breathing necessary during bronchoscopy under topical anesthesia for patients in poor physical status and with respiratory depression or convulsions owing to the systemic effects of the topical anesthetic.

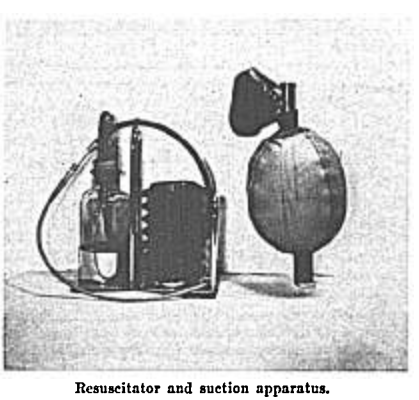
He compared the tidal volumes (see table) moved with a cuirass respirator with the tidal volumes moved with the ventilating bronchoscope in 6 apneic adults (thiopental-succinylcholine). The cuirass respirator moved adequate tidal volumes in the average lean patient, but the data in the table indicate that it may be ineffective under the following conditions: (1) Reduced lung-chest distensibility (obesity, pulmonary fibrosis, pulmonary edema, emphysema). (2) Airway obstruction (bronchoconstriction, bronchial secretions). (3) Unsatisfactory fit of the cuirass over the patient's chest and abdomen. Dr. Safar did not study the newer types of cuirass respirators which exert the pressure changes over larger areas of the patient's body.

With the bronchoscope described above tidal volumes of 1,000 ml. or more could be moved even in the patients with decreased lung-chest distensibility and increased airway resistance, by increasing the pressure on the breathing bag. After insertion of the bronchoscope under thiopental-succinylcholine, an intravenous drip of succinylcholine was continued and unconsciousness was maintained with about 60 per cent nitrous oxide in oxygen. Examination could be performed satisfactorily in all patients. The glass obturator did not become cloudy, probably because of the high flow of dry anesthetic gases in a semiclosed system.

Dr. Safar wishes to thank Dr. N. Cinco and Dr. L. Escarraga for their cooperation and assistance. This study was supported by the Research and Development Division, Department of the Army, Contract DA-49-007-MD-858.

COMBINATION RESUSCITATOR AND ASPIRATOR

Dr. Henning Ruben of the Finsen Institute of Copenhagen, Denmark, has devised equipment (see illustration) consisting of two components, a resuscitator and an apparatus for suction, both independent of compressed gases or electricity.



Resuscitator and suction apparatus.

The *resuscitator* consists of a bag and mask (as shown diagrammatically) with a connection piece in between. It thus looks like and is handled like the common bag-and-mask. The bag, however, is self-expanding and does not need compressed gases to feed air into the bag. This is made possible by lining the inside of the bag with foam rubber of a specially constructed shape. The atmospheric air is sucked in through a nonreturn valve in the tail of the bag during expansion.

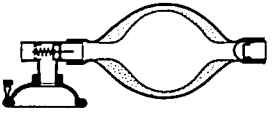


Diagram of resuscitator with foam rubber self-expanding bag.

In the connection piece, a nonrebreathing valve of the same design as earlier described by Dr. Ruben (ANESTHESIOLOGY 16: 643, 1955) prevents exhaled air from coming back into the bag. The exhalation part of the nonrebreathing valve is omitted here, however, so that the exhaled air passes into the ambient atmosphere, practically without resistance.

The *suction apparatus* (see diagram) also is fully independent of electrical power or water or gas pressure. It consists of a trap bottle and a concertina bag, which produces the suction during expansion (activated by a strong spring). The bag is compressed intermittently with the foot. The device, made from corrosion resistent material, avoids the disadvantages of piston-type suction apparatus, as there are no problems of friction or leakage. The suction apparatus can be cleaned without taking it apart by merely flushing cleaning or disinfecting solution through it.

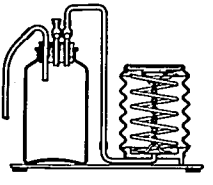


Diagram of suction apparatus.

The resuscitator and the suction apparatus have both proven reliable in practice, and with them resuscitation is possible under the most adverse conditions.

The names and addresses of the manufacturers of apparatus described in the Journal can be obtained from ANESTHESIOLOGY, 3 Penn Center Plaza, Philadelphia 2, Pennsylvania.