



Rolling cabinet for anesthetic equipment.

cabinet, which can be purchased at any Sears, Roebuck and Company store, has eight drawers in graded sizes (see illustration). The two upper drawers are excellent for multiple-dose vials and ampul medications. The second and third drawers are sufficient in depth for endotracheal tubes of varying sizes. The fourth drawer can hold laryngoscopes, and the other drawers, blood pressure cuffs and other bulky equipment. The bottom panel with cylinder lock fits over the two bottom drawers and locks all eight drawers at once. Properly grounded, this cabinet can be rolled quickly from operating room to operating room. The unit is relatively inexpensive, slightly less than \$60.00.

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

## CASE REPORTS

### Morphine, Biliary Spasm and Nalorphine

Drs. Milton H. Alper, and Leroy D. Vandam, of Boston report a case in which pain developed in the biliary tract following the administration of morphine for preanesthetic medication and was relieved by a narcotic antagonist. Their experience and that of others<sup>1</sup> indicates that this is more likely to occur in the patient who has had prior biliary tract disease.

A 55 year old man was admitted to hospital with left calf pain and swelling which had subsided somewhat with rest and elevation. He gave a history of difficulty with varicosities in the legs and was treated by ligation. At the age of 48, following frequent attacks of gaseousness, fatty food intolerance and pain, he had undergone cholecystectomy. Symptoms persisted after operation, but to a milder degree. Physical examination showed lesser saphenous vein varicosities, incompetent communicating veins, and slight swelling in the left calf. He was prepared for ligation and stripping of veins under spinal anesthesia.

Because of apprehension, preanesthetic medication was heavier than usual and consisted of 150 mg. of pentobarbital orally at 8:30 p.m. and morphine sulphate 10 mg. by hypodermic injection at 9:00 a.m. At 10:00 a.m. the patient noted nausea and upper abdominal crampy pain mostly in the epigastric region. He had poorly localized tenderness with some muscle spasm in the upper abdomen. Following discussion with the surgeon,

and since the blood pressure, pulse and respiration were normal, it was decided to proceed with operation. The pain seemed to be typical of that seen in others following the administration of morphine. After induction of spinal anesthesia and the attainment of a sensory level to pinprick at T<sub>10</sub>, the patient was placed in the prone position. However, increase in the severity of abdominal pain prompted the injection of 0.4 mg. of atropine intravenously. This was without effect. After 10 minutes 5 mg. nalorphine was injected intravenously with subsidence of pain within 30 seconds. Operation then continued uneventfully and there was no recurrence of pain during or after operation. The patient refused to grant permission for a test dose of morphine which might have more specifically demonstrated the pharmacologic antagonism.

*Comment.* Among the many side effects of morphine is the production of smooth muscle spasm which can give rise to severe abdominal colic.<sup>2</sup> Pain is especially apt to occur in patients with so-called biliary dyskinesia or post-cholecystectomy syndrome. Presumably the onset of pain is related to the direct stimulating action of morphine on the smooth muscle of the sphincter of Oddi or the duodenum which causes an abrupt increase in common bile duct pressure. Meperidine has also been shown to

cause spasm and pain but to a lesser degree than morphine.<sup>3</sup> Since this action is not mediated over autonomic pathways, relief with injection of atropine, although a suggested remedy, cannot be expected. In the past, relief from pain, though short-lived, has been attained with administration of amyl nitrite, trinitroglycerine, or theophylline.<sup>1, 4, 5</sup>

The narcotic-antagonizing property of nalorphine has been tested for the effect on spasm of the choledochal sphincter induced by morphine. In studies on patients with a T-tube in the common bile duct, nalorphine has been shown to cause a prompt decrease in elevated common bile duct pressure which invariably follows morphine. Prior injection of the antagonist prevents spasm.<sup>6</sup> To the best of knowledge there have been no studies of this nature involving antagonism of the effects of meperidine or the use of levallorphan as an antagonist.

Although not proved beyond doubt, this case illustrates antagonism by nalorphine of morphine-induced biliary tract spasm in a patient with previous biliary disease. This treatment

should be helpful in other instances of this nature. Once more an undesirable side effect of morphine has been demonstrated and doubt cast upon its utility in routine preanesthetic preparation.

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### Subcutaneous Emphysema as a Complication of Endotracheal Intubation

In the past 18 months, Drs. Robert H. Smith, Leland L. Pool and Perry P. Volpitto of Augusta, Georgia, have observed two instances of subcutaneous emphysema following traumatic intubation. Both were elderly women with loose subcutaneous tissues, and had poor teeth and short necks to complicate intubation. Residents in training intubated both utilizing an apneic technique. In the first patient, intubation was accomplished on the third attempt. In the second patient, intubation was accomplished on the fourth attempt. In each case, one effort failed because the effect of the relaxant had worn off, and laryngospasm developed. The patients were ventilated with considerable resistance until added relaxant became effective. After intubation both patients were noted to have subcutaneous emphysema over the neck, up to the mandible. The second patient, in addition, showed subcutaneous crepitation in front of the right ear.

The first patient had an uneventful recovery with prompt absorption of the air, and no symptoms referable to the problem. The second patient had subcutaneous emphysema, but

no mediastinal emphysema postoperatively. She came to post-mortem examination eight days later, two days after a second operation. The necropsy showed, among other findings, mediastinitis without fluid or air, and no pneumothorax. Before her second operation she was evaluated by fluoroscopy, and by roentgenograms which ruled out mediastinitis. It was a consensus of all concerned that her mediastinitis was a complication not connected with her death.

An effort was made to duplicate the problem and to see how it might have occurred. Cadavers of sufficient freshness not to have rigor of the lower jaw and for whom prompt autopsy permits had been signed, were used. The first cadaver was an elderly, edentulous male with poor skin turgor. Under direct vision an eight inch, 17 gauge needle was introduced into the pharynx and eased under the mucosa on the medial aspect of the right piriform sinus. Introduction of 50 cc. of air by syringe gave mild crepitation on the right side of the neck, but not enough air to show easily by roentgenogram. An additional 50 cc.

of air gave definite swelling of the right neck. As illustrated, air went down the neck and into the mediastinum. It went into the retroesophageal space, upward to the base of the skull, and downward into the mediastinum. The illustration is retouched to show how 100 cc. of air bulged the cervical soft tissues. This roentgenogram shows the upper limit of gas to be the mandible, so one must assume the air to be under the superficial fascia of the neck. Massaging upward over the air pocket in the neck reduced the size of the pocket, but whether air was forced up into the subcutaneous areas above the mandible was questionable. It probably went into the mediastinum.

The second cadaver was used to see if a cut through the mucous membrane in the wall of the piriform sinus would lead to subcutaneous emphysema if the pharynx was subjected to positive pressure with oxygen. An incision  $\frac{3}{8}$  inch long, and just through the mucosa, was made on the lateral wall of the right piriform sinus. A mask was applied to the face and oxygen at 30 mm. of mercury pressure was



FIG. 1. First cadaver, showing air in the neck and mediastinum (retouched to show how 100 cc. of air bulged the cervical soft tissues).

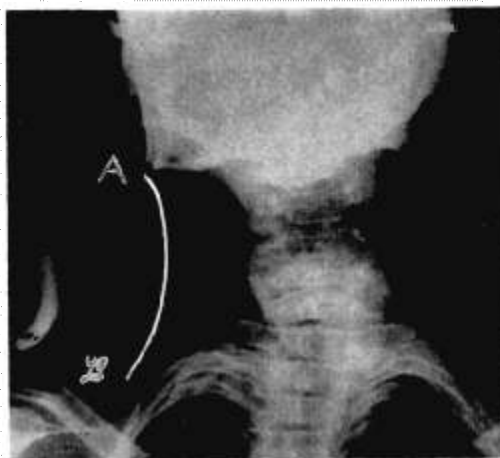


FIG. 2. Second cadaver, showing air in right side of neck out to angle of jaw. The soft tissue was pushed out to the line A-B by air.

applied by squeezing the reservoir bag for less than one minute. The illustration shows subcutaneous gas in the right side of the neck out to the angle of the jaw. It also shows air entering the mediastinum as in the first cadaver. The neck was distorted by the subcutaneous gas, and crepitation was palpable.

Immediately outside the mucosa is an areolar connective tissue space which lies between the thyroid cartilage laterally and the arytenoid cartilage and its muscles medially. This space contains the inferior and superior laryngeal nerves and vessels.

From a piriform sinus mucosal rent, an easy route for upward spread of air is available along the superior laryngeal nerves and vessels and out of the larynx through their aperture in the thyrohyoid membrane. This air will emerge between the visceral fascial sheath and the superficial layer of deep cervical fascia (or that which invests the sternocleidomastoid and the trapezius). The air will enter the carotid triangle with only the most superficial layer of deep fascia separating it from the superficial fascia proper (subcutaneous tissue). Since the superficial layer of deep fascia is pierced by both vessels and nerves at several sites, these openings permit air spread into the subcutaneous layer.

From the rent in the piriform recess, gas may spread *downward* along the course of the inferior laryngeal nerve just posterior to the

cricothyroid joint, and thus out of the larynx and into the areolar tissue in the tracheoesophageal sulcus. On both sides the tracheoesophageal sulcus and the pathway of the recurrent nerves can guide the air readily downward into the mediastinum.

### Failure with Epidural Technique

Dr. Kenneth S. Weiss of Chicago reports a case in which failure to establish epidural anesthesia was due to an unsuspected cause.

The patient was a 60 year old, white female, 5 feet tall, weighing 160 pounds, in good health, with a preoperative diagnosis of acute cholecystitis. The epidural space was easily located by the loss of resistance method of Dogliotti and a 3.5F radio-opaque nylon ureteral catheter easily passed into the epidural space, for a distance of 5 cm. The patient was then turned on her back from the right lateral position and a 5-cc. test dose of 2 per cent lidocaine was injected. Sensory anesthesia developed over the distribution of the first and second lumbar nerves on the right side, as evidenced by the absence of pain sensation to a needle point. A preliminary roentgenogram was then taken to determine the position of the patient over the cassette, in the event an operative cholangiogram should be necessary. Twenty cubic centimeters of 2 per cent lidocaine with 1:200,000 epinephrine were then slowly injected. After a period of 10 minutes in which there was no anesthesia over the operative site, the surgeon infiltrated 1 per cent procaine over the right subcostal margin and the incision was made. The surgeon was assured that since there was a positive response to the test dose, anesthesia would be forthcoming. A slow drip of 0.5 per cent thiopental was started as the patient was becoming very restless and talking loudly. After waiting 20 minutes with no apparent anesthesia, another 15 cc. of 2 per cent lidocaine with epinephrine 1:200,000 were given. By this time the surgeon was entering the abdominal cavity and the patient was pushing and grunting loudly. Since the situation was such that the surgery was impossible the patient was given nitrous oxide with an increase in the rate of the thiopental drip and a continuous succinyl-

In summary, a mucosal tear on either the medial or lateral wall of the piriform sinus, to which gas is applied under pressure, is a route for gas and infectious material to reach the subcutaneous areas of the neck, and the mediastinum.



FIG. 1. Arrow points to exit of catheter from epidural space through the first and second right lumbar intervertebral foramen into the paravertebral space.

choline infusion started. A cholecystectomy was performed and the operation finished in one and one-half hours.

By chance, it was noticed on the preoperative roentgenogram that the catheter had entered the epidural space at the second and third lumbar interspace and had passed out of the epidural space into the paravertebral space through the right intervertebral foramen, one segment higher. (Note arrow on illustration.) This accounted for anesthesia over the distribution of the first and second lumbar nerves which was obtained from the test dose, but no further anesthesia from the full anesthetic dose.

## Retrobulbar Hemorrhage from Nasotracheal Intubation

Drs. Marcia Scott and Verne L. Brechner of Los Angeles report a case in which an ill advised but seemingly atraumatic nasotracheal intubation resulted in an acute retrobulbar hemorrhage.

A 41 year old female was brought to surgery because of recurrent epistaxis from a neoplasm involving the right maxillary, frontal and ethmoid cells. Preoperatively she complained of numbness, pain, and tenderness over the distribution of the maxillary nerve. There was puffiness and prominence of the right eye and the sinus was opaque to transillumination. Laminograms showed a homogeneous density of the antrum but no destruction of bony margins.



Retrobulbar hemorrhage on the right. Note: Swelling of periorbital tissues and proptosis.

Anesthesia was induced by the intravenous injection of sodium thiopental. A well lubricated no. 7 soft rubber catheter was easily introduced via the right nares to the oropharynx; withdrawn 1-2 inches and reinserted

between the cords. A vague blueness was immediately noted beneath the right eye. Within minutes the periorbital tissue became ecchymotic, progressive proptosis of the right eye was apparent and bright blood welled from the nostril. It was felt that the hemorrhage was related to probable fracture of the ethmoid cells, and the medial wall of the orbit by the tube, the bony structure having already been weakened by tumor. Ophthalmoscopic examination showed that despite severe retrobulbar hemorrhage, the central artery of the retina was pulsating and immediate surgical decompression of the orbit was not necessary.

On entering the antrum through the mouth a polypoid gelatinous tumor was found occupying the antrum and eroding into the orbit, the frontal and ethmoid sinuses and through the nasal septum. It was not possible to demonstrate the exact area where intubation had resulted in fracture of the ethmoid and orbit. Frozen section was reported as fibromyxomatous tissue with possible foci of fibrosarcoma. After excision of the tumor and turbinates, ethmoidectomy and partial resection of the nasal septum, periorbital swelling had diminished strikingly. The postoperative course has been uneventful. Pressure dressings were applied for the first 48 hours, and there has been no evidence of impaired vision.

There are few contraindications to the nasal route of tracheal intubation. Obviously, it should be avoided where tumor involves the sinuses. However, in the event of retrobulbar hemorrhage from any cause mechanical obstruction of the retinal circulation can be revealed by fundoscopic examination. If the vessels of the fundus do not pulsate emergency decompression of the orbit is imperative.

## Anesthetic Management of Patient with Myotonia Dysphrica

Drs. Edward A. Talmage of Miami, Florida, and F. B. McKechnie of Richmond, Virginia, report a case of a patient with true myotonia dysphrica to whom thiopental-succinylcholine-nitrous oxide anesthesia was administered during cholecystectomy.

A 49 year old, white male patient was admitted to Jackson Memorial Hospital on February 25, 1958, for a cholecystectomy and operative cholangiography to relieve intermittent jaundice due to cholelithiasis. He had progressive myotonia dysphrica of 14 years standing as confirmed by electromyography and muscle biopsy in the Neuro-medical Clinic at Jackson Memorial Hospital.

Physical examination revealed a chronically ill patient with a trace of icterus and frontal baldness exhibiting the characteristic facies of myotonia dystrophica. His speech was slurred and difficult to understand. Except for symmetrical muscle atrophy of the extremities and minimal right upper quadrant tenderness, the physical examination was not remarkable. His weight was 149 pounds; height, 5 feet 8 inches; and blood pressure 120/80 mm. of mercury.

Hemoglobin, hematocrit, urine analysis, blood urea nitrogen, fasting blood sugar, serum albumin and globulin levels, chest roentgenogram and electrocardiogram were all reported to be normal.

The patient was satisfactorily premedicated with pentobarbital 100 mg., meperidine 75 mg., and atropine 0.4 mg. given intramuscularly at 7:00 a.m. An adequate venoclysis was established and anesthesia began at 8:00 a.m. with thiopental 250 mg. Succinylcholine 40 mg. was given and the lungs ventilated with oxygen by intermittent positive pressure bag and mask. A no. 10 Portex Magill cuffed endotracheal tube was passed with ease, and satisfactory tube placement was confirmed by obtaining clear breath sounds over both lung fields after copious thick mucoid secretions were aspirated from the trachea. Maintenance was attempted employing intermittent thiopental and meperidine to supplement nitrous oxide-oxygen 3:1 liters/minute via a semiclosed Foregger circle filter no. 1. As spontaneous respiration resumed, manual assistance was easily rendered, although the entire skeletal musculature became spastic. Additional thiopental and meperidine failed to provide satisfactory operating conditions even when respiration was controlled by manual hyperventilation. Succinylcholine 10 mg. provided adequate relaxation, and another 10 mg. dose was required five minutes later. A continuous succinylcholine drip (0.2 per cent) was then started to provide an even degree of relaxation. Respiration was controlled. Optimal relaxation prevailed facilitating the exposure of the gall bladder bed which was far up under a narrow costal angle in this patient.

Cholecystectomy, choledochostomy, and operative cholangiography were performed. The peritoneum was closed at 9:40 a.m. when the succinylcholine drip was discontinued. Spontaneous respiration resumed at 9:45 a.m. and required no assistance after 9:55 a.m. Closure of the extensive subcostal flap type incision was delayed until 10:45 a.m. by troublesome bleeding from the right rectus abdominalis muscle and technical difficulties with an interrupted wire technique. Whole blood 500 ml. was started to replace an estimated loss of 650 ml. After dressing the abdominal wound, elective tracheostomy was done to facilitate control of pulmonary secretions during the postoperative period. The patient was awakened, extubated, and taken to the recovery room at 11:45 a.m. The blood pressure during the entire procedure had varied between 110/80 mm. of mercury, and 90/60 mm. of mercury; the heart rate between

90-100/minute. Total thiopental dosage was 800 mg.; meperidine 50 mg.; succinylcholine 160 mg.; 5 per cent glucose in water 800 ml., and whole blood 500 ml.

During the first postoperative day considerable secretions were aspirated from the tracheostomy via sterile tracheostomy Y tube suction. The postoperative course was afebrile, but a slight patchy atelectasis seen by roentgenogram on the third postoperative day was absent on a repeat film 48 hours later. The tracheostomy tube was removed on the fifth day and the patient discharged for clinic followup on the eleventh postoperative day.

According to Tyler<sup>1</sup> myotonia dystrophica consists of the following symptoms coming on in adult life: myotonia, muscle atrophy, cataracts, testicular atrophy, and frontal baldness, although the latter three may not be present simultaneously. Myotonia denotes the inability of involved skeletal muscle to relax normally after contraction and results from a repetitive discharge at the motor end-plate. Myotonia may exist in the periphery of the body where it is accompanied early by a severe symmetrical muscle atrophy. The central form of the myotonia consists of expressionless facies, levator palpebrae paresis, loss of ability to move the lips distorting the speech, and weakness of the sternocleidomastoids producing a characteristic fixed attitude of the head and neck. Neurological examination reveals no sensory or motor lesion except the myotonic reaction at the motor end-plate.

According to Monrad-Krohn<sup>2</sup> the myotonic reaction consists of a series of slow worm-like contractions proceeding from cathode to anode in response to a galvanic or direct current. In severe cases, a current of only minimal strength produces a sustained tetanic contraction known as the "complete myotonic reaction of Remak." In response to a faradic or alternating current, the myotonic muscle remains contracted for some seconds after the current has stopped. Recent observations have failed to implicate as an etiologic factor either lowered cholinesterase activity or any other direct abnormality of the chemical mediator system.<sup>3</sup> Large doses of atropine (0.5 and 1.0 mg./kg.) improved both the speed and completeness of relaxation in the myotonic goat under sodium pentobarbital anesthesia.

Adriani considers diseases of the muscles generally to contraindicate the use of muscle relaxants and nonvolatile agents, advocating

cyclopropane.<sup>4</sup> Dundee<sup>5</sup> has cautioned that respiratory depression and muscular flaccidity are readily produced by even minimal amounts of thiopental. He ascribes this to a noncurare-like peripheral action of thiopental stating that myotonics react normally to curare. In fact, quinine has been employed therapeutically in myotonia for its curare-like effect.<sup>1</sup>

Primarily to obtain a nonexplosive technique for operative cholangiography, thiopental, nitrous oxide, and succinylcholine were employed as described. Our patient failed to demonstrate any sensitivity to thiopental; rather, he exhibited a tetanic state necessitating the use of succinylcholine for its abatement. Perhaps the initial dose of succinylcholine so altered conditions at the motor end-plate that Dundee's postulated muscular flaccidity could not occur in response to thiopental. The initial depolarizing action (cholinergic) of succinylcholine might, on the other hand, have been the factor triggering the tetanic reaction. Or, more likely, the endotracheal tube under light anesthesia set off a cholinergic reflexogenic motor neuron bombardment of the skeletal

musculature which triggered the tetanic reaction. Nevertheless, succinylcholine in ordinary clinical dosage controls this tetanic state, and it appears that the neuromuscular defect in myotonics does not alter the pharmacologic response to succinylcholine. Although this patient did not have impaired pulmonary function, his inability to cough effectively necessitated tracheostomy to control his pulmonary secretions.

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#### Pretracheal Abscess after Transtracheal Analgesia

Dr. W. Curtis Pearcey of Denver and Captain Jack O. Benson of the USAF report a complication of transtracheal analgesia.

An 86 year old, white man on examination was found to have no femoral, popliteal, or dorsalis pedis pulses. He had atrial fibrillation, was receiving digitalis, and had a history of previous myocardial infarction. There was no cardiac decompensation, and his vital signs were normal. Prior to surgery he was heparinized and clotting times were about eleven minutes.

On March 8 a right femoral thromboendarterectomy was performed. The patient was given a transtracheal injection of 2 cc. of 2 per cent lidocaine, and anesthesia was maintained with nitrous oxide by endotracheal tube, meperidine and thiopental. Operative and anesthetic courses were satisfactory. On March 9 the operative site was re-explored to evacuate clots, and again the patient was given 2 cc. of 2 per cent lidocaine transtracheally, a tracheal tube was inserted, and anesthesia was main-

tained with nitrous oxide, meperidine and thiopental. In the evening of the same day a hematoma formed in the surgical wound and was evacuated. Nitrous oxide, meperidine and thiopental were again given, but on this occasion transtracheal analgesia was not performed.

On March 10, the second day after his original surgery, a repeat arteriotomy and endarterectomy were performed. Again the patient was given 2 cc. of 2 per cent lidocaine transtracheally, followed by nitrous oxide, meperidine and thiopental. By the time of this fourth operation, the patient was almost moribund.

On March 16, the right leg was amputated at mid thigh under ethylene anesthesia by mask.

In three days this patient had four operations, and was given three transtracheal injections. A fifth operation, without transtracheal analgesia, was performed eight days after his first surgery.

April 3, 26 days from his first surgery, 24



days from his last transtracheal injection, and 18 days from his last anesthetic, a tracheostomy was performed because of progressive difficulty in breathing and accumulation of secretions in the tracheo-bronchial tree. As the pretracheal fascia was separated, an abscess cavity was entered, and found to contain 100 cc. of pus. No cultures were taken. Prior to the tracheostomy incision, the abscess had not been suspected. In retrospect, his febrile course and respiratory difficulty may be attributable to the abscess. The patient continued to deteriorate, and died the next day. Permission for autopsy was refused.

### "Unguis Dominantis"

Clifton Dance, Jr., M.D., Ft. Lauderdale, Florida, reports an occupational hazard to anesthesiologists, consisting of a partial detachment of the nail from the nail bed following utilization of the hand for intermittent pressure on the bag for controlled respiration. He suffered three episodes of this affliction, all following control of respiration for periods of about six hours in patients paralyzed by succinylcholine.

The first sign was tenderness of the affected area appearing about four hours after continuous control of respiration. A darkening (reddening) of a portion of the nail bed followed, and for about 24 hours tenderness could be elicited by pressure on the nail or movement of the nail on the nail bed. After 24 hours the tenderness diminished and the dark, reddened area became progressively lighter until it was lighter than the rest of the nail bed. Light striations then appeared: usually vertical, sometimes horizontal, occasionally cumulous. The tenderness now disappeared and did not reappear unless further trauma was imposed. Within 48 hours the affected portion of the nail became separated from the bed (a process probably hastened by scrubbing of the hands with a brush for routine anesthesiological procedures) permitting air to enter the subungual space producing the typical appearance in the accompanying photograph.

In two instances the radial side of the nail of the middle finger was affected, in the other the ulnar side of the nail of the little finger,

Since there was no instrumentation of the neck other than the transtracheal injections, these procedures must be incriminated as the starting point of the abscess. On theoretical grounds this is reasonable.

Contamination is possible in any patient given transtracheal analgesia. However, clinical infection, with abscess formation, is certainly unusual. In this patient multiple injections, old age, heparinization with possible hematoma from the needle puncture, and the debility of serious illness probably combined to allow formation of a serious complication.

both focal points of pressure when grasping a smooth, slippery rubber bag such as was utilized. In both cases a manometer was incorporated in the breathing circuit and positive pressure averaged between 10 and 18 cm. of water, and at no time exceeded 20 cm.

No specific treatment was required, the situation being remedied by normal growth of the nail, which took almost three months in the instance illustrated. No particular precautions were taken to avoid further trauma, the anesthesiologist continuing to use controlled respirations as usual, however, he changed hands



*Unguis Dominantis*, occupational hazard to anesthesiologists, partial detachment of the nail following utilization of the hand for intermittent pressure on the bag for controlled respiration.



whenever tenderness appeared. It was felt that this complication could be avoided by using a bag with an easily grippable surface and changing hands at suitable intervals.

*Unguis Dominantis* translated means "nail of the tyrant, despot, one who dominates." Originally, Dr. Dance planned to call the condition Controller's Nail, or *Unguis Controllensis*. However, it seems that French put together two words *contre* meaning counter and *role* meaning register and derived a word that basically means the register

kept at the counter or desk in a hotel. He believes both *contre* and *role* are originally of Latin origin, but apparently their usage together is strictly French. He consulted Latin scholars (Speech and Latin Departments, St. Joseph's College, Rensselaer, Indiana), and they informed him after much disputation that it would be inconsistent to use the words controller and unguis together. He then found the word *dominator* which seemed to approximate his meaning fairly closely. The Latin scholars checked the form and case endings of the phrase *Unguis Dominantis* and assured him this form was correct and appropriate.

## CORRESPONDENCE

### Metabolic Acidosis and Hyperventilation

*To the Editor.*—The title of the article "Metabolic Acidosis of Hyperventilation Produced by Controlled Respiration" by Drs. Papadopoulos and Keats [ANESTHESIOLOGY 20: 156, 1959], seems misleading. The observations of slight variable degrees of metabolic acidosis during anaesthesia with or without hyperventilation, hypoventilation, hyperthermia or hypo-

thermia are well known to those who have carried out blood studies on patients during anaesthesia. However, I cannot see how the

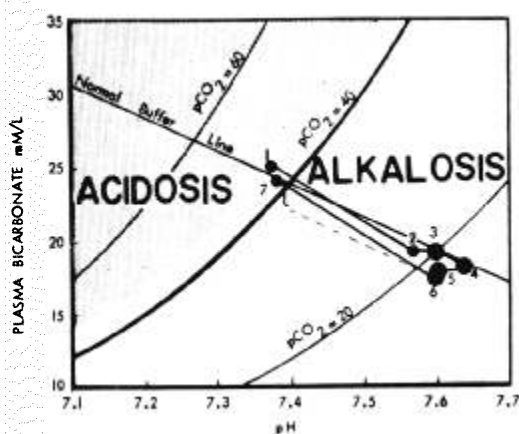


FIG. 1. Represents mean values and standard error of the means of the plasma bicarbonate, pH and  $p\text{CO}_2$  from a variable number of observations: before anaesthesia (1), after 10 min. (2), after 1 hr. (3), after 2 hrs. (4), after 3 hrs. (5), after 4 hrs. (6), and post anaesthesia (7). These values are taken from the analysed arterial blood data reported by Drs. Papadopoulos and Keats, ANESTHESIOLOGY 20: 156, 1959, (tables 1 & 2). Observe that after 2 hrs. of hyperventilation there is no change in the plasma bicarbonate (corrected to pH 7.4), and that even after 4 hours of hyperventilation the change (difference of the means) is hardly more than would be expected in the normal daily variation.

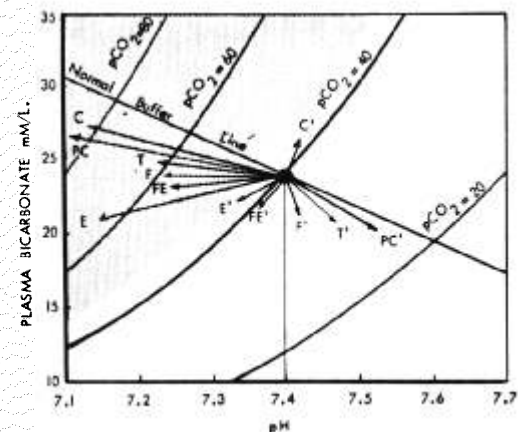


FIG. 2. Represents the usual mean values of plasma bicarbonate, pH and  $p\text{CO}_2$  before premedication, and after a stable surgical plane of anaesthesia (patient in the supine horizontal position) with thiopental-d-tubocurarine-nitrous oxide (PC), trichlorethylene-nitrous oxide (T), Fluothane-nitrous oxide (F), Fluothane-ether azotrope-nitrous oxide (FE), diethyl ether-nitrous oxide (E) and cyclopropane-oxygen (C). The vectors identified with a superscript (') represent the changes observed when pulmonary ventilation is controlled according to a predetermined tidal volume, pressure amplitude, phase ratio and rate of breathing. The other vectors represent the changes observed when ventilation is not adequately assisted or controlled, or when breathing is spontaneous. A non-rebreathing system or Mapleson A System (Magill attachment) with high gas flows (8 to 14 liters) were used to procure all these data except for cyclopropane-oxygen, for which the closed circle system was used.