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

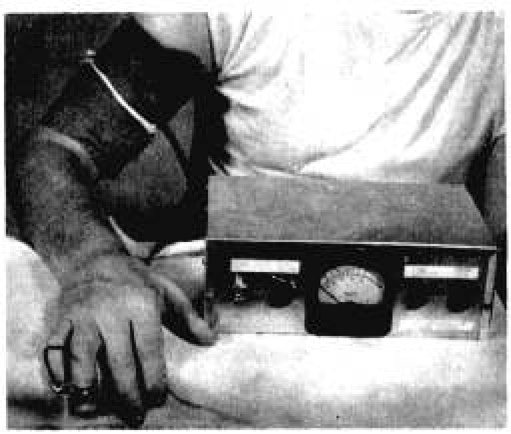


Fig. 1. Application of the Photo-Sphygmometer to the measurement of blood pressure, showing blood pressure cuff and photocell in place. *Controls on the monitor from left to right:* power on-off, tone level, signal indicating meter, light intensity, and sensitivity.

closely approximate systolic pressure at the level of the cuff.

In addition to the measurements of normal blood pressure, this system is applicable where the blood pressure cannot be readily determined by the auscultatory method. These include hypotension, while extracorporeal circulation is being used, or in infants. The system is very sensitive and free from most forms of interference. Placement of the photocell-lamp assembly is not critical, operator error is small, and there is no patient discomfort. Measurements are necessarily intermittent and, as with other methods, error will be introduced due to the effect of gravity if the pickup point is not approximately at the level of the heart. Vascular spasms which make the fluctuations hard to detect may be encountered in certain circumstances as during hypothermia. This difficulty may be obviated by a finger block.

Figure 2 indicates a circuit which can be used to connect the photocell-lamp assembly to an oscilloscope or graphic recorder. The photocell is a Clairex CL-4 which was chosen for its high efficiency, spectral sensitivity (maximum at 6,900Å), and other technical considerations. This type photocell was found to be best for this application. Relatively little light is needed and to conserve battery power and to avoid discomfort from overheating the tissue it is desirable to use a low power lamp (200 mw. or less). Laryngoscope and similar small size lamps work well.

Light intensity at the photocell (I), its resistance ($R2$), and the voltage across it (Ec) are related as follows: $R2 \propto 1/I$, $Ec = (R2/[R1 + R2])E1$. When the pickup is clipped onto a finger tip (or elsewhere), light will be transmitted through the tissue to the photocell and some proportional voltage (Ec) will result. In connection with blood pressure measurements, the only changes in Ec that are of interest are those which occur with each cardiac cycle. These may be separated from other slower changes and from the average value of Ec by the use of a capacitor-resistor network. $C1$ should be chosen so that, with the input impedance of the instrument, a time constant of about 1 second is obtained. To avoid excessive loading of the photocell, the input impedance should be 100 K or higher.

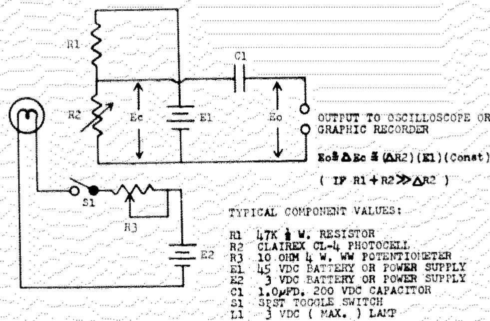


FIG. 2. A circuit which can be used to connect photocell-lamp assembly to oscilloscope or graphic recorder.

These conditions provide for good reproduction of the desired signal and rejection of others. Use of amplifiers with poor low frequency response results in signal loss and may make the detection of low level fluctuations impossible. Most of the transistorized cardiac monitors do not make satisfactory amplifier-

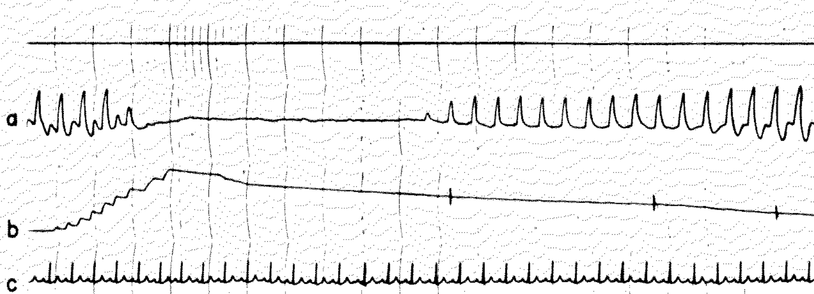


FIG. 3. Tracing obtained by connecting photocell circuit to a graphic recorder. (a) Amplified (A.C.) output from the photocell. Upward excursions indicate decreased light transmission. (b) Cuff pressure. (c) Electrocardiogram.

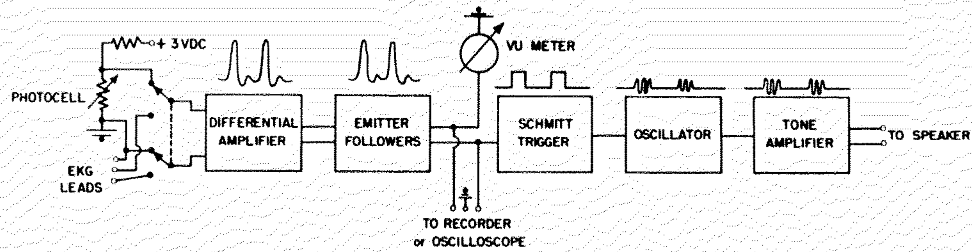


FIG. 4. Block Diagram of the transistorized monitor.

indicators when used with the photocell pickup for this reason and also because they have a low input impedance.

When the circuit of figure 2 is used with the recommended values and is connected to an instrument having an input impedance of one megohm, the signal level from the pickup will be in the 100 millivolt range. Reducing the battery voltage (*E1*) to three volts will reduce the signal level by a factor of about 10 and this range works well with conventional electrocardiographic instruments.

Figure 3 illustrates one type of tracing that can be obtained by connecting the photocell circuit to a graphic recorder. Cuff pressure was recorded simultaneously so that it could be related to the photocell signal.

The block diagram of the transistorized monitor is given in figure 4. The differential amplifier consists of three stages. It has excellent low frequency response and a voltage gain of approximately 3,500. The common signal rejection is better than 60 decibels and the noise level is about − 35 decibels. A low impedance output (emitter follower stage) is provided for driving a graphic recorder or an oscilloscope and the output is monitored with a VU (ballistic) meter.

The Schmitt trigger produces a wave form which has a constant amplitude and a width that is proportional to the duration of the fluctuation originating at the photocell. This wave form keys the audio-oscillator which in turn drives the tone amplifier and the speaker.

The electronic section requires plus and minus 3 volts (D.C.) at about 4 milliamps. The lamp requires a maximum of 3 volts (D.C.) at 250 milliamps. Both are supplied

PULSE / EKG AMPLIFIER-MONITOR

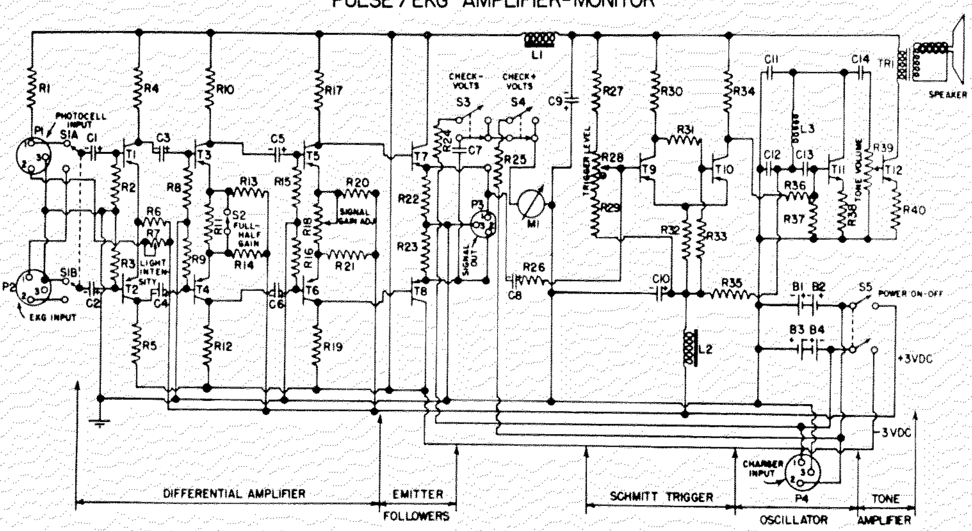


FIG. 5. The complete circuit of the monitor.

PARTS LIST FOR PULSE/EKG AMPLIFIER-MONITOR

R1, R29, R30, R34, R35	4.7K ½ watt 10% resistors
R2, R3, R8, R9, R15, R16, R33, R37	10K ½ watt 10% resistors
R4, R5, R6, R10, R12, R17, R19	6.2K ½ watt 10% resistors
R11, R22, R23, R26	2K ½ watt 10% resistors
R13, R14, R20, R21	12K ½ watt 10% resistors
R24, R25	15K ½ watt 10% resistors
R27, R36	27K ½ watt 10% resistors
R31	22K ½ watt 10% resistors
R32	1K ½ watt 10% resistors
R38, R40	100 ohm ½ watt 10% resistors
R7	10 ohm wire wound potentiometer
R18, R28, R39	5K potentiometer
C1, C2, C3, C4, C5, C6	10 mfd. 15WVDC electrolytic
C7, C9, C10	100 mfd. 15WVDC electrolytic
C8	25 mfd. 15WVDC electrolytic
C11, C12, C14	0.1 mfd. ceramic disc
C13	0.05 mfd. ceramic disc
L1, L2	1.25 Henry filter choke
L3	200 mh choke
TR1	500:3.5 ohm output transformer
M1	Volume level meter
S1	DPDT Toggle switch
S2	SPST Toggle switch
S3, S4	SPDT Push button switch
S5	DPST Toggle switch
P1, P2	Cannon XLR 3–14 receptacle
P3	Cannon XLR 3–13 receptacle
P4	Amphenol 126–218 5 pin socket
B1, B2, B3, B4	Nickel cadmium size D cells
T1–T8, T12	2N188A transistors
T9, T10	2N414 transistors
T11	2N169A transistor

by 4 size D nickel cadmium cells. These have long life and are rechargeable. The complete circuit of the monitor is shown in figure 5.

This method differs from those previously presented by others in several important aspects. The fluctuations cycle in contrast to occlusion plethysmographic techniques which measure slow fluctuations in total volume. The pickup device is not pressure sensitive, thus placement is not critical and it does not have to exert force on the tissue. The method is considerably more sensitive than others that were tried and the signal obtained is unusually free from artifact.

Editors Note: Since submission of this article the authors report that a photocell with higher sensitivity and other special components have been found. Inquiries regarding these developments can be directed to the authors through the Journal Office.

Chamber for Anesthetization of Small Animals

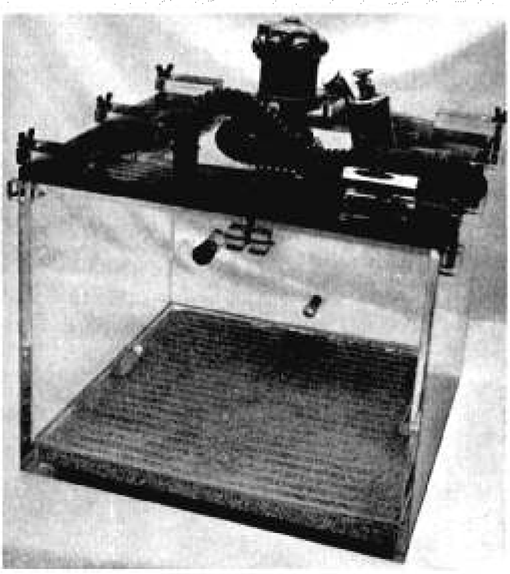
Drs. Howard L. Zauder and Louis R. Orkin of New York City note that it frequently becomes necessary to anesthetize small animals with a known, reproducible concentration of anesthetic agent when studying the effects of volatile and gaseous anesthetics. A variety of chambers have been used and are on the whole unsatisfactory. They either make no provision for circulation of explosive gases, are not air tight, or are not adaptable for use with both volatile liquids and gases. The chamber * they describe permits anesthetization of animals with both types of anesthetic agents while pro-

* This chamber was designed and constructed for use in an investigation supported by the Research and Development Division, Office of the Surgeon General, Department of the Army, under Contract No. DA-49-007-MD-962.

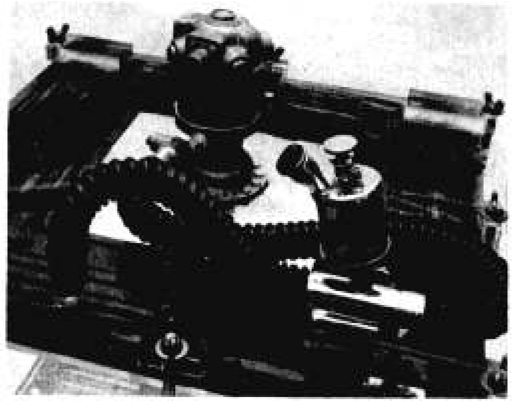
viding for constant circulation of the gases and carbon dioxide absorption.

The chamber, measuring 20 × 20 × 16 inches internally (illustrated), is fabricated of one-half inch plexiglas. The rim is beveled to a blunt knife edge (one-sixteenth inch). Eight "dog ears" tighten a one-eighth inch corded rubber gasket which is cemented to the lid of the chamber down onto the knife edge making a gas tight seal. An internal ledge of one inch by one-quarter inch plexiglas supports a one-quarter inch thick shelf off the bottom of the chamber. In addition to two rows of slits at three-quarter inch intervals to permit free gas exchange, this shelf has two handles mounted on its upper surface to facilitate removal for cleaning and the replacement of the carbon dioxide absorber which fills the space below. The volume of the chamber is determined by subtracting the volume occupied by the shelf, ledge, and carbon dioxide absorber from the volume of the cube. Each of the two chambers in current use has a volume of 99.7 liters.

Two of the side walls as well as the top are drilled to accept seven-eighth inch plexiglas tubing. Standard rebreathing tubing can be fitted to these ports as necessary. A 24 volt, explosion-proof aircraft fuel booster pump is mounted over a three inch hole in the lid as illustrated. This pump, powered through an



The anesthetic chamber as used for vaporization of volatile liquids in air.



Close up of the lid of the anesthetic chamber showing the position of the pump and vaporizer as well as detailed construction of the "dog ears."

isolation transformer, stepdown transformer, and rectifier, circulates the gases at a rate of 35–45 liters per minute as measured by a Monaghan ventilation meter. The outlet of the pump is connected to the port on the lid of the chamber by means of one inch corrugated rubber tubing.

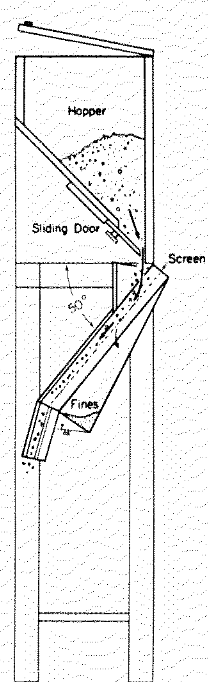
When liquid agents are to be volatilized in room air, the side ports are corked and a Peterson ether vaporizer or T connection with a syringe is interposed between the pump and the port on the lid. The amount of liquid necessary to achieve the desired concentration of vapor is calculated from the standard gas equations. An anesthesia machine can be attached to the side port and the chamber flushed when an increase in oxygen concentration is desirable. Oxygen concentration is determined by dropping the sampling tube of a Pauling meter (Beckman) through a one-holed rubber stopper in any of the ports or by dropping it through the rubber tubing from the pump to the top port. When gaseous agents are employed gas mixtures flow from the anesthesia machine into the side port. The port on the opposite side of the chamber is vented to the outside of the building by means of a piece of rubber tubing. When the desired concentration as judged by oximeter readings is achieved, flow rates are decreased so that anesthesia can be maintained with the use of minimal amounts of agent.

A group of 10 mice placed in the chamber for one hour period will take up less than one per cent of the total oxygen. Over a twenty-four hour period 10 mice will deplete the total oxygen concentration by eight per cent as determined by oximeter.

Utilizing this chamber, it has been possible to repeatedly anesthetize mice to the desired depth of surgical anesthesia with 1.5 per cent halothane (Fluothane), 6–7 per cent diethyl ether, and 6–7 per cent divinyl ether. It is not possible to anesthetize mice with unsupplemented nitrous oxide by this technique unless hypoxic concentrations are employed. Cyclopropane in a 50 per cent concentration will induce anesthesia. Following induction this agent may be added intermittently to maintain the desired depth of anesthesia. The chamber has been used for rats and cats as well as for mice. In the former case three to five animals are placed in the chamber at one time, but only one cat can be anesthetized at any time. With the larger animals it becomes necessary to correct for the volume occupied by the animal in calculating the concentration of the volatile agent.

Soda Lime Dispenser

Drs. J. L. Martin and William K. Hamilton of Iowa City, Iowa, have designed a dispenser which facilitates convenient cannister filling with separation of most of the undesirable fines. The presence of "fines" and dust in soda-lime is considered to be undesirable because of increased resistance to gas flow, increased channeling of gases through the absorber and the possibility of inhalation of dust by patients. It appears inevitable that some fines are present when soda lime is received in the hospital. The dispenser is illustrated in the accompanying figure. A sifter has been designed which passes the soda lime over a screen allowing the fines to sift through. The remaining soda lime passes into a cannister. The hopper is of appropriate size to accommodate the contents of a 37-pound can of soda lime. The sliding door opening is 1 inch wide at the bottom, 4 inches wide at the top and 3 inches high. This allows a graduated increase in the amount of soda lime passed over the screen. The screen is 8 × 8 mesh hardware cloth about 6 inches wide and 15 inches long. A screen angle of 50 degrees has been found to provide a satisfactory rate of flow of soda lime. The spout has a 1-inch opening to deliver soda lime directly into the cannister. Direct delivery decreases regranualizing produced by transfer from container to container. The screen and spout are covered to prevent scattering. A trap below the screen collects the fines for discard.



Soda lime dispenser.

Super-Syringe

Clinton D. Janney, Ph.D., of The Roswell Park Memorial Institute, Buffalo, New York, believes that there frequently occur, in both laboratory and clinical work, situations in which it is convenient to have a simple, accurate means of delivering known volumes of gas. This communication describes an instrument which he has developed for the purpose of making convenient measurements of gas volumes pertinent to respiration and is called the "super-syringe." A very similar device has been described by E. Goodwyn (The Connexion of Life With Respiration. London, J. Johnson, 1788) who used it for artificial respiration.

The super-syringe, as illustrated, consists essentially of a piston (A) and cylinder (B) made from acrylic plastic. The piston is sealed with a commercial U-cup * packing (C). A handle (D) passes through one end of the cylinder and is attached to the piston. The length of the stroke of the piston is determined by a series of stops (rods) (E) which lie parallel to the cylinder axis and which are attached to the piston along a circular arc concentric with the cylinder, so as to look somewhat like organ pipes. When the piston is fully withdrawn, these stops pass through an arcuate slot (F) in the end of the cylinder. In operation, the piston and stop assembly is rotated to the proper angular position and then withdrawn until one of the stops bears against the end of the cylinder at location G. Thus, the piston position and the volume contained within the cylinder are precisely determined. Then the piston is pushed all of the way forward so that it "bottoms" against the end of the cylinder, expelling this precisely determined volume of air. In making these instruments, we usually adjust the lengths of the stops so that each one provides an integral number of deciliters of delivered volume. To calibrate, we make micrometer measurements of the diameter of the cylinder and the length of the stroke, and calculate the volume.

* This is similar to an O-ring except that its cross-section is U-shaped instead of round. Its advantage is in a lower friction, although some lubrication is still needed.

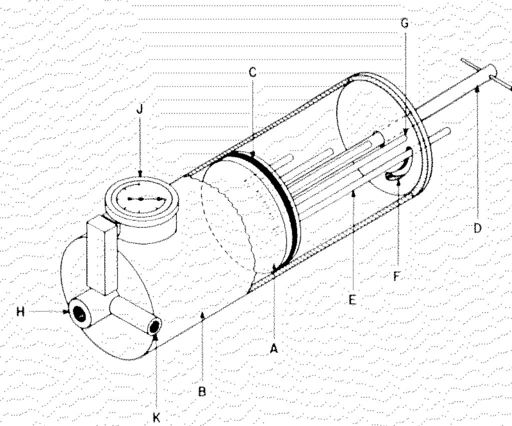


Diagram of super-syringe.

The outlet (H) from the cylinder is provided with a female taper which fits a standard tracheal tube fitting. An O-ring is used to insure a tight seal. An aneroid manometer (J) measures the pressure required for delivery of the air from the cylinder. The reading of

Super-syringe as held for use. This one has a capacity of 1.5 liters in 500 ml. steps.

this gauge and the delivered volume can be used to compute lung-thorax compliance.

The side tube (K) has been added to provide for convenient manipulation. During the withdrawal stroke, it is left open; during the delivery stroke, it is closed with the thumb or a finger, as illustrated.

Uses of the super-syringe have included: (a) calibration of pneumograph, (b) calibration of reservoirs such as bellows and bags, (c) calibration of areas (representing volume) under flow curves, (d) estimates of lung-thorax compliance, (e) estimates of fluothane concentrations, (f) preparation of gas mixtures, (g) demonstration in patients to correlate inflated volume and visible expansion of chest and abdomen, and (h) demonstration of variable excursions of breathing bag with the same simulated tidal volumes but with different inflow rates.

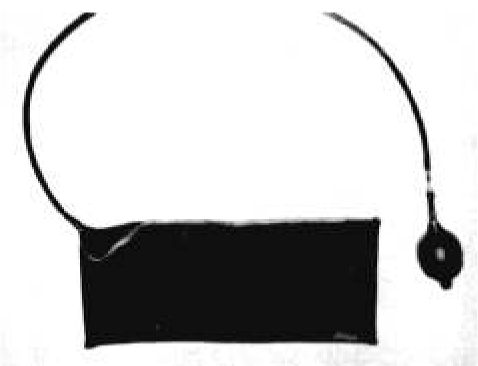
Supported in part by funds provided under Contract DA-49-007-MD-507 with the Research and Development Command, Office of the Surgeon General, Department of the Army.

Inflatable "Rest"

Dr. Edwin M. Fuller of Derby, Connecticut, reports that sometime ago one of his surgeons requested some sort of "rest" to replace the metal type found on many tables or a folded sheet or a sand bag for use during gall bladder surgery to enhance exposure.

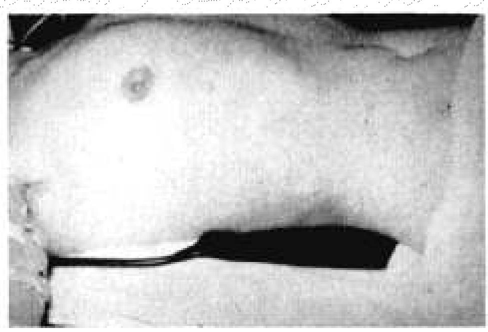
He discussed the problem with a representative of a commercial company. As a result an inflatable "rest" (or pillow) of conductive rubber, 7 inches wide and 13½ inches long, with a hand bulb and shut-off valve for inflation was made. Dr. Fuller has used this device in several hundred cases since July 1957.

Although originally intended for gall bladder patients, he has used the "rest" in a variety of cases: upper abdominal surgery (such as gall

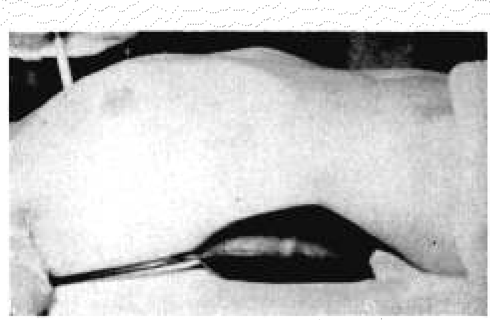


"Rest" not inflated.

"Rest" inflated.



"Rest" in position (not inflated).



"Rest" in position (inflated).

bladder, gastrectomy); lower abdominal surgery; head and neck surgery (including tonsillectomies, thyroidectomies); breast, thoracic and shoulder surgery. It is of value when the patient is in the lateral position to relieve pressure on the axillary nerves and vessels.

Dr. Fuller believes that the "rest" is less traumatic than the metal ones on the table, folded sheets, towels or sand bags. It is placed comfortably under the conscious patient in position on the table and is inflated after the patient is asleep. He has also found that patients rarely complain of backache when the "rest" is used under the back while in supine or lithotomy position. It fills the lumbar curve and gives gentle support to the back muscles.

He has recorded no changes in blood pressure when the "rest" is inflated.

Modified Tuohy Needle

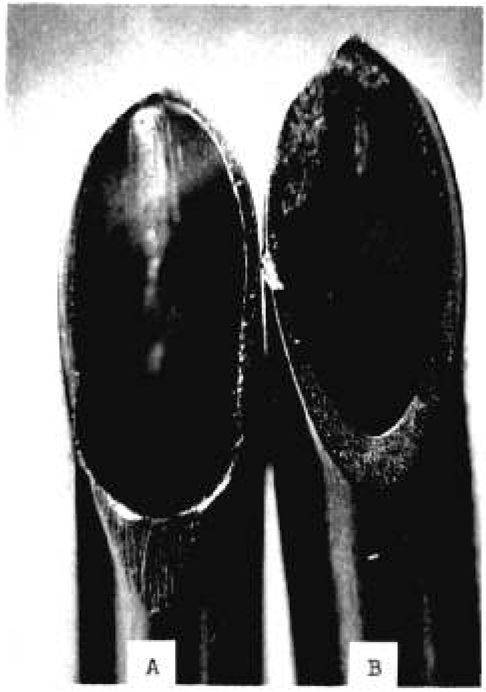
While performing an epidural block recently, Drs. Ralph Friz and Robert Loehning of Salt Lake City had a plastic catheter shear off in the epidural space during manipulation of the catheter. This prompted them to investigate the possibility of eliminating this hazard from continuous epidural anesthesia.

The beveled end of a Tuohy needle has a razor sharp edge and an acute angle at the base of the bevel. (Note needle *b* in the photograph.)

A catheter was threaded through a 16 Tuohy needle with the point of the needle close to the palm of the hand. This required the catheter to make a 90 degree angle, similar to that which it would make in the epidural space. With this procedure it was found that the slightest withdrawal of the catheter through the needle resulted in the catheter being sheared off by the base of the bevel.

They found that this hazard could be eliminated by filing the base of the bevel with the tip of a "rat-tailed" file or a fine dental bur. The sharp edge was filed blunt, and the acute angle was rounded. (Note needle *a* in the photograph.)

When the catheter was threaded through the needle under the same conditions as before, creating a 90 degree or greater flexion of the catheter, it was virtually impossible to shear off the catheter. With a strong pull, some shaving of the catheter resulted, when it was flexed more than 90 degrees.



The beveled end of Tuohy needle (b); modified Tuohy needle (a).

They have modified all of their Tuohy needles as described above, and have obtained similar results. This modification has not impared the usefulness of these needles for the insertion of catheters in the epidural space.

Anesthetic Cabinet

In a search to find a permanent, mobile yet inexpensive anesthetic cabinet, Drs. William M. Hall and R. C. Lincicome of Parkersburg, West Virginia, found a rolling tool cabinet which satisfactorily fills most of the requirements for the practicing anesthesiologist. This

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 [1] 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_{10}, 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.[2] Pain is especially apt to occur in patients with so-called biliary dyskinesia or postcholecystectomy 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