to rest against the cheek. Because of the weighted offset handle the instrument is self-retaining and will remain wherever it is placed. The angle of the mouth serves as a fulcrum and because this point is closer to the handle than to the tip, little force is transmitted by the tip against the tracheal mucosa. The endotracheal tube is then inserted by direct vision in the usual manner by advancing its end alongside the rod which is holding the epiglottis elevated to permit an unobstructed visual path into the trachea. When the endotracheal tube is in place the rod is withdrawn. This one sized instrument can be used in all adults.

During the past three years the seven members of our department have used this instrument when glottic exposure was difficult in approximately 400 cases without complication. It has facilitated many intubations that might otherwise have been impossible with the usual techniques.

A Quantitative Technique for the Evaluation of Peripheral Neuromuscular Blockade in Man

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There is a definite need for an accurate method of continuously monitoring the effects of neuromuscular blocking agents in man during operation and in the immediate postoperative period. Clinical evaluation of the degree of muscular relaxation and of respiratory depression is frequently inadequate and occasionally in error because of the subjective nature of the evaluation and the unavailability of a universally applicable standard for comparison.

Churchill-Davidson [1] and Katz [2] have recently introduced portable peripheral nerve stimulators into clinical anesthesia. These devices, together with clinical judgment, are useful for continuously monitoring the type and degree of neuromuscular blockade. It is suggested that with experience one is able to recognize a small change in finger movement and to evaluate the strength of the muscle response of a given patient.[2] This report will describe a more accurate and objective method for quantitating the degree of relaxant induced neuromuscular blockade in anesthetized man. One of us (A. S. N.) has adapted a diaphragm type pneumatic pressure gauge and pediatric blood pressure cuff air bladder into a compact unit. When used in conjunction with the Block-Aid Monitor * it is capable of accurately quantitating the variation in the indirectly induced muscular twitch and tetanus. The scale units are millimeters of mercury.

The instrument is composed of readily available items (fig. 1): (1) Block-Aid Monitor, (2) diaphragm type pneumatic pressure gauge,† (3) plastic sump type stomach tube, (4) blood pressure cuff inflating bulb with usual Air-Flo control, (5) pediatric blood pressure cuff air bladder, and (6) Luer lock fittings, ace bandage. The instrument is simply assembled by connecting one end of the plastic tubing to the pressure gauge and the other to the air bladder. The air bladder is folded on itself to measure 2½ × 1¼ inches and taped securely. The blood pressure bulb is attached to the side arm of the sump tube.

Method of Use. Prior to induction of anesthesia, the air bladder is placed in the patient's palm making sure the four fingers are in position of flexion and in contact with the air bladder (fig. 1). It is held in this position

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* Block-Aid Monitor available from Burroughs Wellcome & Co. (USA) Inc., Tuckahoe, New York.
† Drawn steel case diaphragm gauges, Marshall Town Manufacturing, Inc. Distributed by John G. Kelly, Inc., New York City.

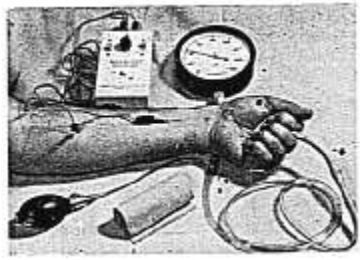

FIG. 1. Items necessary for the quantitative measurement of peripheral neuromuscular transmission. Note particularly the position of the air bladder in relation to the fingers and the placement of the stimulating electrode at the motor point of the flexion digitorum profundus.

by wrapping the hand with an ace bandage and securing the arm to the arm board. Following the induction of anesthesia the needle electrodes are positioned in the volar surface of the forearm. The stimulating electrode (22 gauge, 1½ inch metal needle) is placed perpendicularly through the upper ¼ of the flexor digitorus profundus as in figure 2. In this position the motor point of the muscle ‡ rather than the nerve trunk is stimulated to produce a flexion-grip response. The indifferent electrode is placed in the superficial cutaneous area of the wrist.

After charging the system with air to register 40 mm. of mercury the Block-Aid Monitor is turned to the highest setting for supramaximal twitch stimulation. The flexion-grip response results in a compression of the air bladder by the fingers. This compression response is quantitated in mm. of mercury by observing the needle deflections of the pneumatic pressure gauge. This method of numerically quantitating a response is inherently superior to the more qualitative method previously suggested. The large, easy-to-read dial minimizes error in interpretation and reduces the amount of experience necessary for proper evaluation. For reference the numerical value of the needle deflection may be recorded as a function of time on the anesthetic record. When muscle relaxants are used, the development of the block is easily followed, its type and adequacy measured, the degree of recovery quantitated, and the necessity of a proper antagonist evaluated and its efficacy determined.

Although the instrument is principally intended for use by the clinical anesthesiologist, it may be modified to serve as a research tool. This is done by simply connecting the pressure gauge end of the plastic tube to an appropriate strain gauge; this in turn is coupled to a suitable polygraph recorder. Figure 2 illustrates the records made with the instrument modified for research purposes. The magnitude of the needle deflections is transcribed at appropriate time intervals on the record; a positive correlation between the

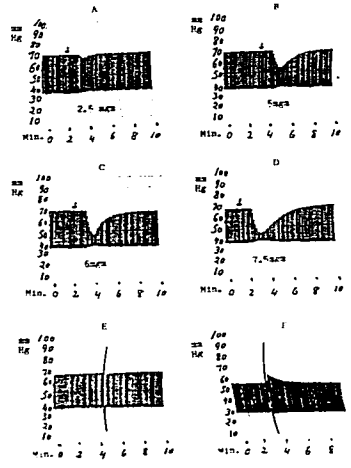

FIG. 2. Examples of polygraph recordings obtained as described in text. They demonstrate the sensitivity of the instrument. The arrows indicate time of relaxant administration. Panels A to D are the records made in a 68-kg. adult male given 2.5, 5, 6 and 7.5 mg. of succinylcholine chloride intravenously during operation. Panel E is a record of the muscle response to a tetanizing current in a patient prior to the administration of relaxant. Panel F is a recording from the same patient 30 minutes after intravenous administration of 6 mg. of *d*-tubocurarine chloride. Post-tetanic facilitation is demonstrated.

‡ This motor point is located 3 inches below the olecranon process and 1½ inches laterally.

polygraph record and pressure gauge measurement exists. The sensitivity of the instrument is indicated in panel A to D of figure 2. Amounts of muscle relaxant less than that usually employed clinically are clearly quantitatable.

This instrument is in daily use in the operating rooms of the Columbia-Presbyterian Medical Center. It has been of value in the recovery room for assessing the degree and type of persistent myoneural blockade and guiding the administration of appropriate therapy. It has also been useful in quantitating the effects of edrophonium and curare when these agents are used to test for the myasthenic syndrome.

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An Anesthetic Machine for Small Mammals

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The machine to be described was built for use in experiments related to the tissue oxygen concentration in the brain of the rat.[1] These experiments involved exposing the anesthetized animal to various concentrations of oxygen in nitrogen, recording the effect on the oxygen content of the brain and testing the protective effect of oxygen deprivation on tissues being irradiated. The requirements for the anesthetic unit were that it should allow easy control of depth and duration of anesthesia, and permit rapid changes from one gas or gas combination to another.

Figure 1 shows a diagrammatic representation of the machine. A primary rank of four solenoid valves (V) served four flowmeters. Three of the flowmeters were calibrated for flows of 100 ml. to 1,000 ml. per minute, while the fourth was calibrated for rates between 5 ml. and 150 ml. per minute. The secondary pair of solenoid valves was arranged so that a particular mixture of oxygen and nitrogen could be made with the gases running to waste, then the desired combination switched into the circuit without delay. The vaporizer circuit was designed to allow gas to flow through the bottle containing ether, and thence to the animal. Provision was made for either partial or total by-pass of the ether bottle, fine control of the gas flow in any of the pathways being obtained by the use of adjustable screw (gate) clips.

MATERIALS

The body of the machine (fig. 2) was constructed entirely from acrylic sheet. The base measured 9 inches × 9 inches × ¾ inch (22.5 × 22.5 × 0.95 cm.), and the overall height was 15 inches (37.5 cm.). None of these dimensions is critical. The gases were supplied to the machine from standard 48 cu. ft. cylinders, via reduction valves of the type B.O.C.12.

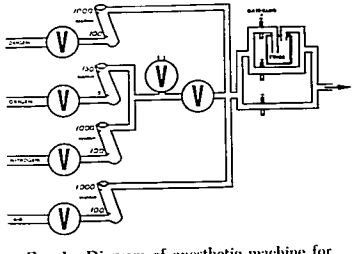

FIG. 1. Diagram of anesthetic machine for small animals.

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