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.

REFERENCES


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.† 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 x 9 inches x 3/4 inch (22.5 x 22.5 x 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.

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Fig. 1. Diagram of anesthetic machine for small animals.
(British Oxygen Company, Wembley, London). The solenoid valves were type LO 2, manufactured by Black Automatic Controls Ltd., Leafield, Corsham, Wilts, England. The flowmeters were made by Rotameter of Croydon, London. The junction of the gas line to the flowmeter tube was made through a cap made of ¼ inch outside diameter nylon rod. Each section of rod was individually drilled out on a lathe to obtain a tight push fit joint with the flowmeter tube. The flowmeters were supported in two horizontal blocks of acrylic, 9 inches x 2 inches x ½ inch (22.5 cm. x 5 cm. x 1.8 cm.). Glass or acrylic tubing of ½ inch outside diameter, ½ inch inside diameter (0.95 cm. outside diameter, 0.31 cm. inside diameter) was used wherever possible to conduct the gases. Rubber connections of any length were only used at the positions of the screw (gate) clips. The primary rank of four solenoid valves was controlled from a bank of four single pole single throw switches, visible on the lower right hand side of the photograph (fig. 2) of the machine. These were mounted on a panel made of ½ inch (0.31 cm.) acrylic sheet. The secondary set of valves was controlled by a double pole single throw switch, so that one valve was always energized, i.e., held open. (This switch does not appear in the photograph.) Also omitted is the 75 feet of twelve strands of electric cable that allowed the machine to be operated remote from the switches, though the junction blocks for this cable can be seen. The final gas mixture was administered to the animal via a face mask made of a suitable diameter of acrylic tube, as shown in figure 3. The rubber sleeve was made from 1 inch diameter (2.5 cm.) Pauls tubing. Not shown in this diagram is a small deflector placed inside the mask set just in front of the inlet pipe to prevent the animal receiving a direct blast of anesthetic gas.

**Function**

For my experiments the machine was used as follows. A Wistar albino rat was weighed, and given 30 mg./kg. body weight of Methohexitone sodium by intra-peritoneal injection. When the animal became sleepy, it was laid on its side and the face mask applied. Air was passed through the machine at a rate of 1,000 ml./minute, and into this the ether was slowly introduced. When the necessary depth of surgical anesthesia had been reached, a needle type of tissue oxygen electrode was inserted into the animal’s left cerebral hemisphere. The air line was then switched off, and oxygen given at the same rate to check the electrode’s function. If a satisfactory response was obtained, the flow rates in the secondary circuit were set, for example 25 ml. oxygen in 975 ml. nitrogen. The 100 per cent oxygen was switched off, and the secondary
circuit mixture switched in. After a fixed period the switching procedure was reversed. At the 1 liter flow rate, the delay between throwing the switches and the gas reaching the animals was about 0.3 seconds. For irradiation work the remote control facility was essential.

The machine was in constant use over two and a half years, and never suffered a major fault. In a series of 230 rats anesthetized using the machine no deaths occurred that could be attributed to machine failure, though its use is an acquired skill.

This machine was built while the author worked in the Department of Experimental Pathology, St. Mary's Hospital, Paddington, and I should like to thank Dr. E. A. Wright for the help, facilities and finance given for its construction.

REFERENCE

Isolated Block of Musculocutaneous and Perineal Nerves in the Management of Spasticity with Special Reference to the Use of a Nerve Stimulator

Ali A. Khalili, M.D.,* and Henry B. Betts, M.D.†

Duchenne described percutaneous electrical stimulation of various nerves for localization of motor lines and motor points a century ago. Samoff used electrical stimulation to determine the functional relation of the spinal cord to the vertebra by an intraspinal catheter in dogs. Samoff and Samoff described the use of electrical stimulation for accurate isolation of phrenic nerves in man. They commented on the usefulness of this technique for peripheral nerve block. Pearson described in detail the efficiency and accuracy of peripheral nerve block with lidocaine solution with the aid of a stimulator. He demonstrated that not only could a nerve be localized accurately, but that specific branches or fiber groups could be isolated and blocked. Greenblatt and Denson described a small, transistorized nerve stimulator and documented its use in locating peripheral motor nerves. Khalili et al. have described the use of nerve block with dilute aqueous phenol in the management of spasticity, following isolation of the nerve fibers by a stimulator. It is the purpose of this paper to describe the apparatus we have used and the technique of isolation of the musculocutaneous and perineal nerves.

APPARATUS

The stimulator essentially consists of a source of electrical energy, a rheostat to regulate the current, an ammeter and a switch (fig. 1). The energy is supplied by a 90-volt dry battery. An ammeter rather than a voltmeter is used for localizing the nerve. The intensity of the current is shown continuously on the ammeter. For accuracy of isolation, two ammeters or one with two scales is advantageous. One shows the intensity in milliamperes, and the other shows the intensity in microamperes.

To eliminate unnecessary frequent stimulation of the nerve, which could be painful or trigger spasticity, switches were introduced to turn the current on and off by hand or foot. Whenever needed, the foot switch gives the operator complete freedom of his hands to facilitate the isolation. The stimulator is connected to active and dispersive electrodes.