

Hospital, Charleston, South Carolina. All muscle relaxants are known to produce a decrease in respiratory exchange. However, the degree of respiratory depression obtained for a standard amount of muscle relaxation is believed to vary with each muscle relaxant. This phenomenon has been defined as the "respiratory-sparing" effect of muscle relaxants. In one investigation, an evaluation of the "respiratory-sparing" effect of the various muscle relaxants demonstrated that respiratory depression was more pronounced after single doses of nondepolarizing relaxants than after depolarizing relaxants (Poulsen, H., and Hougs, W.: *Acta anaesthesiol. scandinav.* 1: 15, 1957). This, however, was not true with rapidly administered single doses of succinylcholine iodide or its derivatives. These conclusions were drawn from experiments in which muscle relaxation in the extremities was compared to the observed decrease in tidal volume. A more pertinent comparison would be the decrease in tidal volume associated with a standard amount of abdominal relaxation. A method of obtaining this comparison is the basis of this report. A resistance strain gauge arch designed to measure heart contractile force was modified in such a way as to become an integral part of an abdominal retractor (Boniface, K. J., Brodie, O. J., and Walton, R. P.: *Proc. Soc. for Exp. Biol. & Med.* 84: 263, 1953). This modification made it possible to measure in grams the force exerted by the abdominal muscles of the dog before and after muscle relaxants. The change in electrical output of the strain gauge arch was amplified by a Brush electronics strain gauge analyzer with a direct inking oscillograph for recording. In pilot experiments, medium-sized mongrel dogs were lightly anesthetized with intravenous pentothal sodium, and the abdomen was opened through a midline incision. The retractor was inserted and the incision separated. A record of the force applied against the retractor was obtained. After a suitable tracing was obtained, an apneic dose of intravenous succinylcholine chloride was administered, following which a continuous record of the change in force was recorded. In 15 experiments, the force exerted on the retractor was reduced on the average from 200 Gm. to 50

Gm. In these experiments, however, no effort was made to measure the "respiratory-sparing" effect of succinylcholine chloride. The same experiment was conducted in 7 patients. The results in these patients were much the same as obtained in the animal experiments. Again, no attempt was made to establish the "respiratory-sparing" effect of succinylcholine chloride. In one patient, the apneic dose of 20 mg. of succinylcholine chloride produced a 50 per cent reduction in the force applied against the retractor. After the patient had recovered from the effects of the succinylcholine chloride and the force against the retractor returned to its previous level, the patient received 9 mg. of *d*-tubocurarine. This was followed by a 50 per cent reduction in the force applied against the retractor with only a 50 per cent decrease in the patient's tidal volume. This would tend to indicate that *d*-tubocurarine has a greater "respiratory-sparing" effect than does succinylcholine chloride in apneic doses.

Our experiments thus far with this method of measuring muscle relaxation has been satisfactory. Future work will be done to establish a "respiratory-sparing" ratio for each muscle relaxant.

Experience With Gas (Absolute) Sterilized Endotracheal Tubes. ROBERT C. HARVEY, M.D., RICHARD N. TERRY, M.D., AND RICHARD AMENT, M.D. *Department of Anesthesiology, Buffalo General Hospital, University of Buffalo School of Medicine, Buffalo, New York.* Recent outbreaks of hospital acquired staphylococcal infection has led to a review of possible sources of cross infection in hospitals. At The Buffalo General Hospital the Infection Committee questioned the reliability of existing methods of sterilization of endotracheal tubes, *i.e.*, a one-minute scrub employing 3 per cent hexachlorophane soap. It was pointed out that areas skipped in scrubbing could constitute a nosocomial infection hazard. Ethylene oxide was selected as offering maximum security for materials of low thermostability. Ethylene oxide is totally effective against all vegetating bacteria and fungi, has exceptional sporicidal activity, and is viricidal for at least the larger forms. A

peculiar advantage is its remarkable penetrability, freely passing through polyethylene film, rubber, and other materials impervious to bacteria. Areas inaccessible to steam and soaking, such as under cuffs, and between tube and metal fittings are fully exposed to bacteriacidal action, making disassembly unnecessary during the sterilizing process. Objects packed in sealed polyethylene bags before sterilization are rendered sterile indefinitely until the seal is broken. Disadvantages observed were: (1) cost, much larger numbers of tubes and fittings required because of time interval between sterilizations, (2) frequent sterilizer breakdowns interrupting service, and (3) deterioration of latex cuffs (18-36 sterilizations) due to heat. Sterilizer operates at 135 F. Sanders tubes and other multiple dip "anode" tubes employing inclusion reinforcement windings are unsuitable for ethylene oxide sterilization due to bubble formation in the tube wall during decompression phase of sterilizer cycle. A serious hazard is created by unnoticed bubbles projecting into the lumen of such tubes. Evaluation of patient response to ethylene oxide sterilized tubes was made by comparing the incidence of postintubation sore throats with our previous experience, and with the incidence reported by others sterilizing by conventional methods. Absence of any significant difference was taken to indicate that mucosal irritation by retained ethylene oxide in endotracheal tubes from the sterilization process was negligible, and that sore throats that might be related to organisms introduced with "subtotally" sterilized tubes were not revealed. To determine if gas sterilization of endotracheal tubes could be related to the incidence of postsurgical infection in our hospital, the incidence of postoperative atelectasis and pneumonia was recorded for a 9-month period before, and a 9-month period after inauguration of gas sterilization. While a small overall reduction was found, a wide fluctuation from month to month persisted through the period of gas sterilization, suggesting that other factors than intubation were predominant. We conclude that "absolute" sterilization with ethylene oxide gas may have advantages over other methods for the treatment of endotracheal tubes from an esthetic, and a medicolegal point of view.

Histologic Changes in the Spinal Cord Following Subarachnoid Alcohol Block.

RICHARD C. HAY, M.D., AND TAKESHI YONEZAWA, M.D. *Section of Anesthesiology, Department of Pathology, The University of Texas, M. D. Anderson Hospital and Tumor Institute, Houston, Texas.* Since our previous report (*Anesthesiology* 19: 102, 1958), the use of subarachnoid alcohol for the relief of intractable pain in patients with terminal malignancy has continued, and has become an established treatment for such patients. For unilateral block, the patient was carefully positioned with the affected side uppermost and rotated about 45 degrees anteriorly. For bilateral block, the patient was placed in the prone position. The site of needle puncture was the level at which the root to be blocked enters the spinal cord; not at the vertebral level corresponding to the involved dermatome. Absolute alcohol was slowly introduced in small quantities, 0.5 to 1.0 cc. per needle. The patient remained in position for 45 minutes following the introduction of the alcohol. From June, 1956, to October, 1959, 170 patients have received 272 subarachnoid alcohol blocks. There have been no serious complications in this group. Of the 170 patients, 84 per cent either required no narcotics or minimal amounts to avoid withdrawal symptoms, considerably less pain with narcotics for complete comfort in 11 per cent, and no relief in the remaining 5 per cent.

During this same period, 16 spinal cords were obtained at autopsy from patients who had had subarachnoid alcohol at varying intervals prior to death. Each cord was grossly examined and its meninges removed. A segment 2 cm. long, including the site of injection as its midpoint, was removed and divided transversely into multiple blocks, each 1 to 2 mm. in thickness. Other specimens were taken above the site of injection at intervals of 1 to 2 cm. and below it at intervals of 2 to 4 cm. Each block was serially sectioned and stained with hematoxylin and eosin, Marchi myelin stain, and Bielschowsky's stain. The changes most frequently found were demyelination and degeneration of the posterior roots, either unilateral or bilateral, and chromatolysis of the nerve cells of the posterior root ganglion. Within the cord itself, the most frequently af-