syringe. Room air is then drawn to the 20-ml mark and the syringe capped with a metal three-way stopcock. From one to ten syringes so prepared are attached to the drum of the mixing device. Equilibrium between liquid and gas phases occurs within 20 to 40 minutes. The gas phase from each specimen is then analyzed by a gas chromatograph or infrared analyzer.

REFERENCES

A Simple Muscle-twitch Monitor

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The Block-Aid nerve stimulator † has gained acceptance as a simply-applied device to assist the continuous monitoring of muscle relaxant activity during clinical anesthesia. This stimulator is as reliable for estimating neuromuscular activity, as is a more elaborate laboratory instrument, but there is currently no simple method to quantitate the muscular response which it evokes objectively. Evaluation of the degree of drug-induced neuromuscular blockade using gross visual observation to estimate the magnitude of muscular activity has been suggested,† but this has obvious limitations.

In an attempt to find a simple, easily applied, inexpensive and readily available device to use as a clinical monitor of muscular activity, we tested a variety of crystal and carbon type pulse monitors, but the reliability and reproducibility of their responses were found to be unsatisfactory. However, we have constructed a simple twitch monitor, using a 10-ml Becton-Dickinson Sani-Lok syringe with three finger rings, an 18-Fr. Pharmaseal suction catheter (K-62) and a Tyco aneroid blood pressure manometer (fig. 1). The syringe must be lightly coated with mineral oil

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FIG. 1. Twitch monitor and nerve stimulator mounted in place.
to prevent sticking, and all fittings must be airtight. The system is filled fully with air under about 50 mm Hg pressure, which causes the syringe plunger to return to an extended position each time it is depressed. The thumb is taped to the plunger and the two finger rings taped to the middle and ring fingers. When the Block-Aid stimulator is applied to the ulnar nerve as described by Katz, the excursion of the needle is within the range of the manometer for single-twitch responses, but a tetanic stimulus may produce a response exceeding 300 mm Hg. It is important that the needle deflection produced by muscle twitch be determined before the administration of any muscle relaxant so that the degree of response at any time can be determined in relation to this initial response. Frequently, there will be some change in the resting position of the needle following administration of relaxants or after administration of a tetanic stimulus, but the degree of needle excursion remains a reliable indicator of muscle activity despite this baseline shift. There is also a tendency to overestimate high degrees of block because of the inertia of the system, and sometimes small muscular movements of the hand are apparent before needle deflections can be detected. Despite these limitations, this system has been found to be useful.

The degrees of block induced by both depolarizing and nondepolarizing muscle relaxants have been measured using the twitch monitor and compared with results obtained with a Grass force-displacement transducer applied to the opposite arm, as described above. Drug-induced twitch depression is easily estimated, with an error of less than 10 per cent at relatively stable degrees of block, but somewhat greater variability occurs with changing conditions, as during onset or reversal of block (Fig. 2). The presence or absence of ill-sustained tetanus and of posttetanic facilitation is easily determined. Reversal of neuromuscular block at the end of anesthesia is readily controlled using the objective measurement this system provides.

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