IN THE LABORATORY

Constriction of the Mid-Thorax as a Means of Reflex Maintenance of Respiration During Barbiturate Narcosis

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Respiratory center depression with serious reduction in the rate and minute volume of breathing is commonly encountered in barbiturate intoxication. The sensitivity of the center to carbon dioxide is lost, or at best materially diminished, and respiration becomes largely, if not entirely, dependent upon reflex drives for its maintenance (*2*). Increase in the rate of breathing of dogs at this stage may be accomplished by compression of the chest, a maneuver initiating reflex drives involving proprioceptive impulses possibly from both the lung (*4*) and the chest wall (*8*). The application of a constricting band about the mid-thorax as a means of eliciting and maintaining this effect is the subject of this report.

Spirometric recordings, using a Basal Metabolic Rate Unit connected to a tracheal cannula, were made for 11 dogs, each under varying degrees of sodium pentobarbital (Nembutal) narcosis. The dogs were anesthetized with initial intravenous doses of 20–25 mg of the drug/kg of body weight. Subsequent doses of 5–10 mg/kg were given at frequent intervals in order to obtain increasing depths of anesthesia. Constriction of the chest was accomplished by the inflation of a sphygmomanometer cuff encircling the mid-thorax.

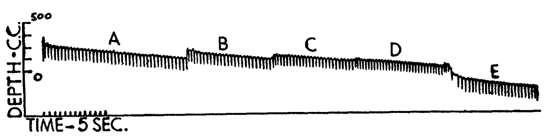

FIG. 1

The stimulating effect of inflation of the cuff upon breathing was immediate at all levels of respiratory depression. During light anesthesia (20–30 mg/kg), inflation of the cuff to various pressures increased respiratory rates slightly and resulted principally in reduction of tidal air volumes (Fig. 1). As toxic levels of the drug were reached (40–60 mg/kg), breathing became abnormally slow (3–5/min). Inflation of the cuff to pressures of 18–24 mm Hg at this point (Fig. 2, arrow) resulted in prompt and significant increases in rates (10–15/min). Tidal air volumes which had increased during the period of abnormally slow breathing were reduced by the constriction to only slightly less than those seen during light anesthesia without constriction, thus assuring adequate tidal gas exchanges (compare Fig. 2, B with Fig. 1, A). The net result was an increase in the minute volume by as much as 115%. Inflation of the cuff to pressures greater than 24 mm Hg reduced tidal air without further increasing the rate. Pressures of as little as 12 mm Hg increased the rate of breathing in some instances. Smaller pressures did not alter respiration. As greater levels of toxicity were reached (60–70 mg/kg), the respiratory minute volume was markedly reduced, principally by a great reduction in the tidal air.

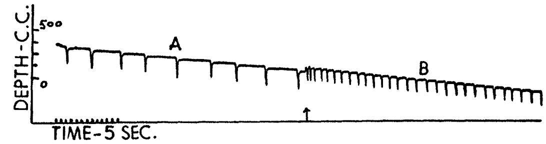

FIG. 2

Constriction of the mid-thorax in this instance resulted in an increase in rate and a slight increase in minute volume, still not sufficient, however, to maintain the animals' oxygen requirements. The respiratory responses to the procedure were maintained in all experiments as long as the cuff was inflated, but promptly disappeared upon deflation.

The effects of constriction, as observed in these experiments, appear to be the result of a Hering-Breuer proprioceptive reflex from the lungs. This is supported by the following observations:

(1) The latent period between the application of the constriction and the response is too short for a chemoceptive reflex (Fig. 2, arrow).

(2) Bilateral vagal section promptly abolishes the effect.

(3) Removal of the common tendinous insertion for the scalenus medius and rectus abdominis muscles does not alter the effect of torso constriction upon respiratory rates or minute volumes in any observable manner. Light digital pressure applied to a circumscribed area of this common tendon (*8*), prior to the latter's removal, initiates a respiratory response. Such responses, however, cease after a few seconds of digital pressure and are followed by a short refractory period.

(4) Nondeforming pressures to the torso and lungs do not give rise to the same type of response as do deforming pressures. The latter apparently deflate the lungs to a greater extent than the former (note elevation of the respiratory base line in Fig. 2, B), thus initiating the excitoinspiratory reflex.

Various chemical, noxious, and proprioceptive reflex mechanisms controlling respiration have long been known (*1, 3, 6*), and methods for their utilization during respiratory center depression have been proposed (*5, 7, 8*). The method as described here is simple, efficient, and nondamaging and is capable of increasing pulmonary ventilation during drug depression. In some experiments animals were able to tolerate the administration of larger doses of the drug (70–75 mg/kg) during the application of the constricting pressure (Fig. 3, first arrow), but upon deflation of the cuff they lapsed into respiratory failure (Fig. 3, second arrow). Attempts made to revive such animals by reinflation of the constricting cuff (Fig. 3, third arrow) or by artificial respiration were futile. These findings seem to indicate that the torso pressure maintained a volley of vagal nerve impulses to the respiratory center and thus increased the latter's resistance to drug toxicity.

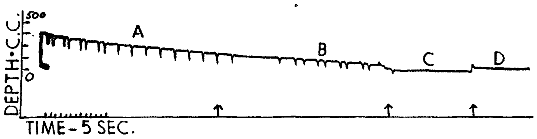

FIG. 3

As yet, sufficient data have not been accumulated for judgment of the efficacy of this maneuver in clinical cases of barbiturate overdosage. Preliminary observations made thus far seem to indicate that it is applicable in such cases.

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A Portable Light for a Dissecting Microscope[1]

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When large numbers of dissections or identifications of insects must be made where no electric current is available, the microscope lamp described below is quite useful. If a microscope must be carried from place to place, the light weight of this lamp is an added advantage.

The whole apparatus is shown in Fig. 1. The source of light (P) is a 'penlight' type lamp (Eveready No. 1152). This is held in a screw-base pilot light socket (H), mounted in the end of a piece of flexible tubing (S) (speedometer cable). The end of the flexible cable remote from the lamp is fastened to a piece of brass, flattened over most of its length to facilitate fastening to the microscope by the screw (A). Mounting in this manner allows the lamp to move up and down with the microscope, thus keeping the light continually on the material being examined. Connection is made with the source of power through a light-weight electric cord using a radio-type midget-tip plug and jack (M). One side of this jack is grounded, as is one side of the socket of the lamp. Thus, only one wire is necessary from the jack to the lamp socket. (The mounting shown is for a Bausch & Lomb microscope. Arrangements for attachment to other makes of microscope will suggest themselves.) Current is supplied by a battery of two standard flashlight cells housed in a plastic case on which is fitted a wire-wound midget voltage control with a resistance of 10 ohms (R). The use of this is necessary, since the lamp which is rated at 2.2 volts is not durable if subjected to the full 3 volts of the battery. The rheostat is mounted on a swinging piece of plastic to facilitate replacing the battery, the shaft of the rheostat making

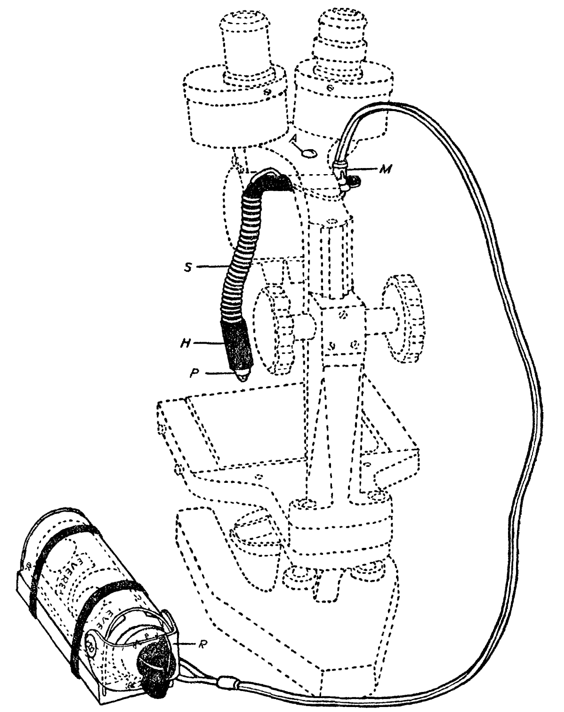

FIG. 1

contact with the tip of the battery when in place. A satisfactory light is provided at 2.2 volts, and if a more intense light is desired for short periods, the rheostat may be adjusted so as to provide the full current of the battery. Satisfactory operation has also been secured from the 6-volt terminals of a transformer, using the proper resistance to reduce the flow of current to the lamp. (Other lamps of higher voltage may be substituted if necessary.)

The chief virtue of the particular lamp used is that a small condensing lens is incorporated in the tip of the lamp itself. The flexible arm is made of such length that the field of the lowest power of the microscope is completely illuminated. The lamp gives off almost no heat.

There is no thought that this apparatus can replace any of the standard microscope lamps. The whole apparatus, including the battery, can be carried in the microscope case, and this complete portability makes it very useful under certain conditions. The total cost of materials is less than $2.00.

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