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The effect of varying pressures upon the abdominal musculature in the cat.By **HELEN C. COOMBS.***[From the Department of Physiology, Columbia University.]*

Sherrington¹ has summarized rather completely our knowledge of tonus for smooth and striated muscle. He believes that muscle fiber is not to be considered as an elastic string, for it has the property of exhibiting different lengths with one and the same degree of tension. This doctrine is of special interest in the case of the abdominal musculature, which is of necessity subject to many changes in pressure due to the many variations which occur in the abdominal contents. We should therefore expect to find the muscle fibers of the abdomen showing different lengths with the same degree of tension, or, to put it conversely, to exhibit a fairly constant pressure with varying increments of volume.

The object of these experiments has been to determine whether this regulation of inter-abdominal pressure is essentially a function of the nervous mechanism of the abdominal walls or of the intrinsic musculature itself.

Cats were used in these experiments under the several conditions of light and deep anesthesia and decerebration. A cannula introduced into the abdominal cavity was connected by a 3-way stopcock with a manometer and a burette filled with 0.9 per cent. sodium chloride solution kept at a temperature of 38 degrees centigrade. Costal respiration was recorded throughout the experiment. The warmed saline was admitted to the abdominal cavity at the rate of 10 c.c. a minute. With each increment of fluid the pressure was read from the manometer and plotted against the volume. A curve was thus obtained for the entire experiment, which, in about fifty cases was found to be typical. There was a slow increase of pressure in proportion to volume until a certain point was reached, from which pressure rose much more rapidly. At this point also, costal respiration increased very greatly in depth to effect a compensation for the lack of adequate abdominal

¹ Sherrington, *Brain*, 1915, xxxviii, 191.

respiration. In many cases the experiments were continued until there was a failure of respiration which was likely to occur when the pressure had risen to from 250 to 300 millimeters of saline. In other cases they were intermitted when respiration was observed to be labored. The curve always had much the same form indicating a slow rise in pressure in proportion to the volume up to a critical point, after which the pressure increased much more rapidly, as though such a point indicated the end of the ability of the musculature to lengthen with a minimum increase in pressure and thereafter exhibited only elasticity.

The anesthesia, when neither very light nor very deep, had no effect upon the pressure, volume remaining constant. Very light anesthesia sent the pressure up, and very deep anesthesia sent it down a little. Decerebration had no effect upon it.

The next step was to determine whether ablation of the motor nerves of the abdominal musculature would have any effect upon the pressure curve. After the control curve had been taken, therefore, the fluid was removed from the abdominal cavity and no further procedures were undertaken for an hour. The three branches of each phrenic nerve were then removed and the filling of the abdominal cavity was repeated.

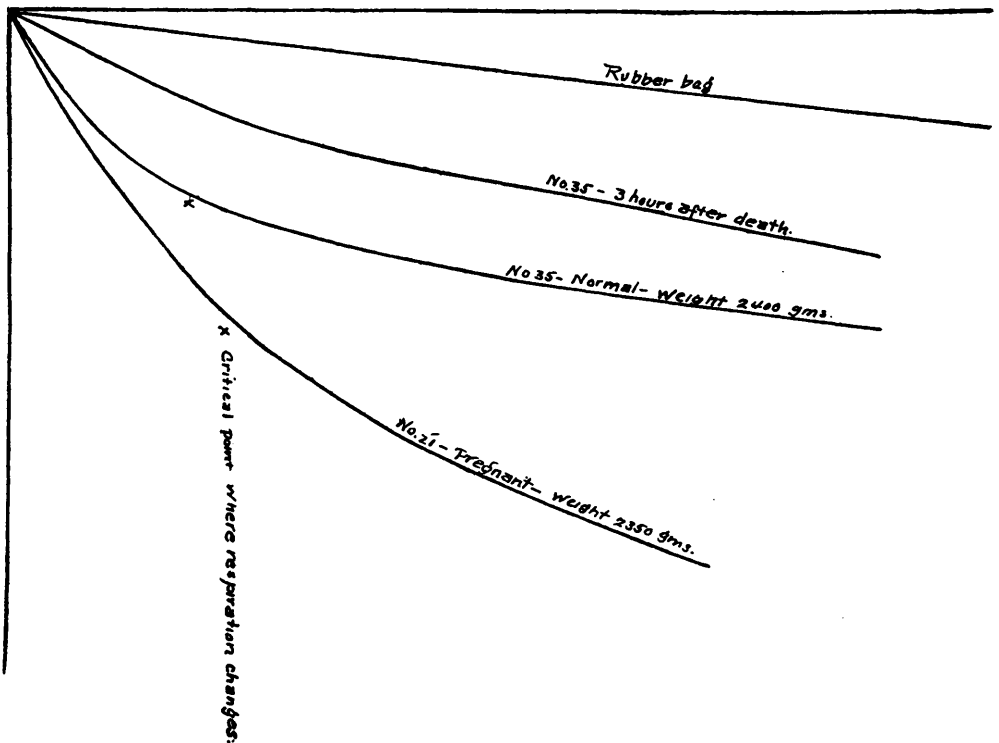
In a similar manner, after obtaining the normal curve in other cats, the ventral roots of the spinal nerves from the mid-thoracic through the lumbar region were destroyed (laminectomy having previously been done) and another curve obtained.

Removal of the phrenics with paralysis of the diaphragm was in all cases found to cause a slight increase in pressure proportionate to volume, and the same was the case with removal of the spinal nerves. The curves, however, were so closely parallel to the normal curve as to be hardly significant. In order to obtain the effect of isolation of the muscle from all motor impulses, curare was injected into the femoral vein of a number of cats and artificial respiration was maintained. There was little variation from the control curve.

After the death of the animal, curves were taken of the pressure at intervals of one and three or two and four hours in order to determine the rôle played by the intrinsic elasticity of the musculature in the maintenance of this curve. With each succeeding

hour after death the pressure curve more closely approximated the straight line exhibited by any elastic body.

The condition of pregnancy is of interest in connection with these experiments. Many cats in varying stages of pregnancy were examined. They all, in proportion to their weight, exhibited a greater degree of extension of the abdominal musculature, with a lesser amount of pressure in proportion to volume, than the non-pregnant cats. Even when the abdominal musculature was greatly distended, these cats appeared capable of the accommodation of a relatively large volume of fluid.



Grey² has pointed out that time is an essential factor in the expression of this lengthening of the muscle fiber with no greater degree of tension. It is probable that the conditions of pregnancy, with the lengthy time factor involved, are far more ideal for demonstrating this particular form of muscular activity than a laboratory experiment can ever be; it is significant that the abla-

² Grey, Ernest G., *Amer. Jour. Physiol.*, 45, 272.

tion of the motor nerves of the abdominal musculature in pregnancy is not more effective in causing alterations of the pressure curve than in the non-pregnant cat. The function appears to be part and parcel of the musculature itself rather than of the extrinsic nerves, although some slight nervous regulation and coördination does undoubtedly exist.

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Coli fever and blood volume in dogs.

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For the continuation of work on the mechanism of fever reduction by drugs we have been seeking a satisfactory method of producing fever in dogs. In these animals a predictable curve of neurogenic fever is very difficult if not impossible to obtain. A few injections of peptone have given us a maximum rise of less than 1° C. with a rapid return to normal within two or three hours (maximum dose employed: 7 c.c. per kilo of 67 per cent. "bactopeptone.")

Turning to injections of killed cultures of colon bacilli we made nineteen experiments with subcutaneous injections of a vaccine containing 325,000 million bacilli per c.c. and in fourteen of these obtained a temperature the following morning (that is, after 15 hours), varying from 0.4° to 1.7° C. above normal. In the other five, no elevation of temperature was seen.

The next procedure was to inject in the morning, following the curve throughout the day. For this purpose a more concentrated vaccine was selected, containing 1,625,000 million bacilli per c.c. In five uncomplicated experiments in which this vaccine was used, maximum temperature increases of 2.4° to 1.5° C. (with hourly readings) were obtained with doses of 1 c.c. per kilo. With ½ c.c. per kilo the maximum increase was 2.4°. A smaller dose (0.2 c.c. per kilo) gave, however, an increase of only