

ON THE FUNCTION OF THE POSTERIOR SPINAL GANGLIA.

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In the course of an investigation on the nature of shock, certain phenomena concerning the influence of the spinal ganglia on the inhibition of shock were observed, and seem worthy of some special notice. In a previous publication¹ the author has described the effect upon the respiration and circulation produced by irritation of the central end of a divided sensory nerve, *i. e.*, the crural nerve, in dogs, and the variation in these effects with different degrees of anesthesia (ether).

During the experiments ether was administered through a tracheal tube. The blood pressure and cardiac contractions were recorded by means of a mercurial manometer, connected with the right carotid artery. The movements of the thorax were recorded by means of the exploring tambour of Paul Bert attached to a strap of adhesive plaster which encircled the lower portion of the chest. This tambour was connected through a rubber tube with a Marey tambour whose writing lever thus recorded the movements of expansion and contraction of the chest. The upstroke represented the inspiratory movement; the downstroke, the expiratory. The time was recorded by means of a metronome beating seconds placed in a circuit with an electrical signal, thus transmitting its rhythm to the signal, which marked the time on the paper of the kymograph.

The right crural nerve was divided and the central end stimulated electrically. For this purpose Du Bois Reymond's apparatus with platinum electrodes was used. An electric signal was placed in the primary circuit of the apparatus, so that the time during which the nerve was irritated was marked on the paper of the kymograph. Many experiments were made on the same animal in various stages of anesthesia. In only one dog was no anesthetic employed. The results here were constant and had been described before, so that I did not deem it justifiable to repeat this experiment.

¹ Kramer, *Annals of Surgery*, 1900, xxxii, 377.

Irritation of the central end of the divided crural nerve in an animal that had received no narcotic always produced the same effect. The respiration was increased in frequency about fifty per cent. and the inspiratory effort was markedly increased. The cardiac rhythm was also increased approximately to the same extent. The blood pressure invariably rose. These effects gradually disappeared after the cessation of the stimulation, so that about one minute thereafter the respiratory rhythm and force were as before, and the same was true of the circulatory apparatus.

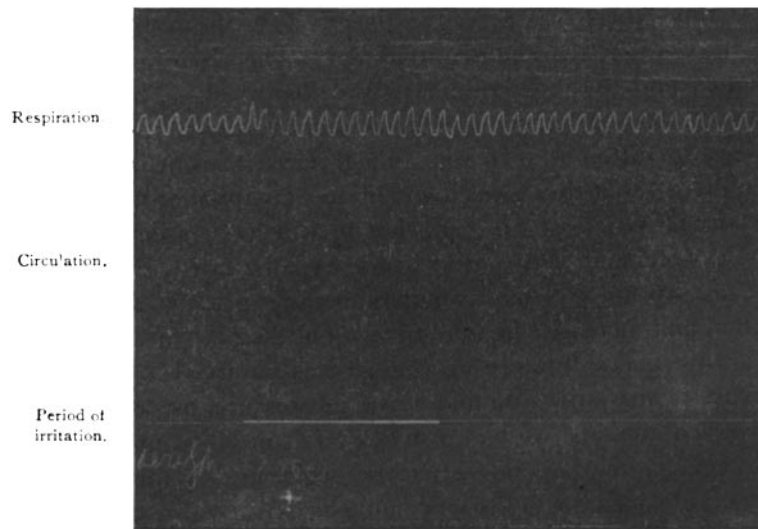
If the animals were deeply narcotized with ether, so that there was absolutely no corneal reflex, the result was very different. In most instances the irritation of the central end of the crural was without effect either upon the circulation or respiration.

At times there was a very slight effect on the respiration in that the inspiration was slightly inhibited. The rhythm remained unchanged and the circulation was not disturbed. There was however, a stage of ether anesthesia during which the effect was materially different. If the animal were anesthetized, but only partially, so that there was a condition of semi-anesthesia, in which the corneal reflex was present, but in which the animal lay quietly on the table, and if the crural nerve were irritated, the respiration, just as in unnarcotized animals, became greatly accelerated in rhythm and increased in amplitude. On the part of the circulatory apparatus, a very interesting change was observed. Instead of an increase in the pulse rate and a rise in pressure, as occurred in unnarcotized animals, we had a marked fall in blood pressure. This fall began a few seconds after the beginning of the irritation of the nerve, lasted for a varying number of seconds, and eventually returned to the level present before the irritation. The fall in blood pressure was greater the more intense the irritation, that is, the nearer the coils of the faradic apparatus were placed.

In every experiment there was a stage of general anesthesia in which irritation of the central end of the crural nerve produced this fall in blood pressure.

Experiments were also made upon animals narcotized with ether with a view of determining the influence of the posterior spinal ganglia on the transmission of these impulses. The posterior roots

were exposed and one of the lower dorsal roots was divided peripherally to the ganglion; the electrodes were applied to the divided posterior root both centrally and peripherally to the ganglion. It was found that the spinal ganglion had an inhibitory effect. That is, a degree of irritation, which, in a given degree of anesthesia was without effect on the circulation or respiration when applied peripherally to the ganglion, would, when applied centrally, that is between the ganglion and the spinal cord, be followed by the "vasomotor shock," described above as following irritation of a sensory nerve during incomplete anesthesia. The spinal ganglion undoubtedly holds back or inhibits the effect of this irritation on its way to the cord and brain.

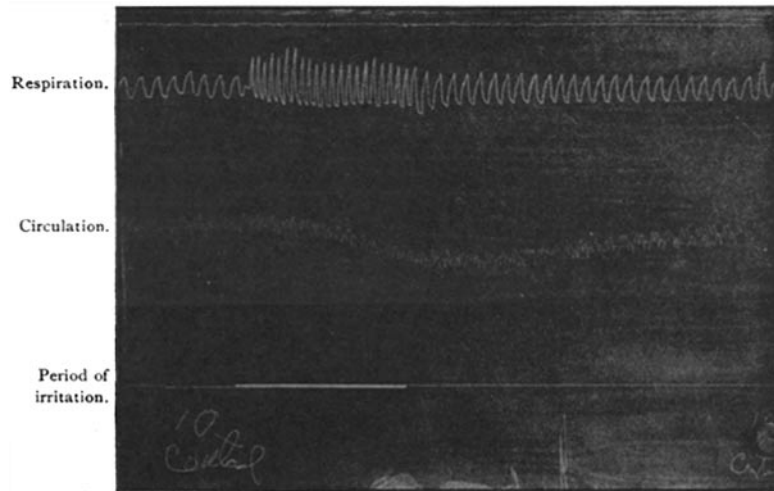


TRACING I. Electrode applied peripherally to the ganglion; anesthesia incomplete; corneal reflex present. Coils of faradic apparatus 10 c.m. apart.

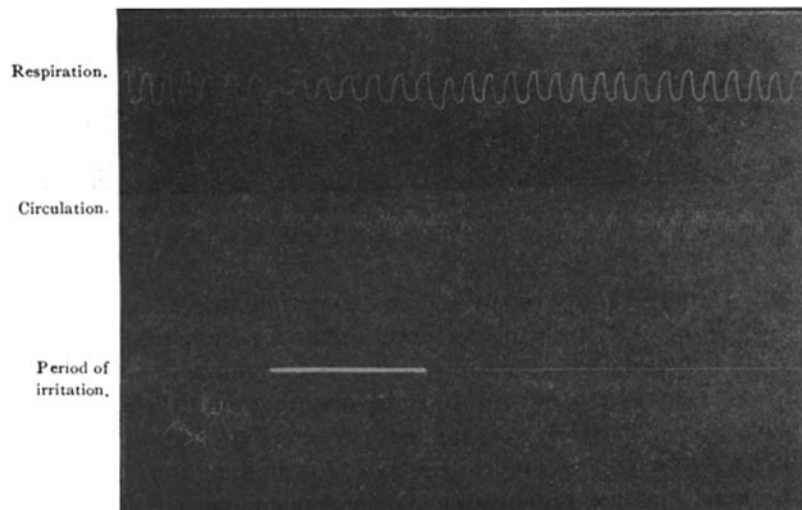
Tracings I and II are records of two experiments on the same dog made about a minute apart. The animal was anesthetized with ether; the corneal reflexes were present. The coils of the faradic apparatus were ten centimeters apart.

Tracing I is a record of an experiment in which the electrodes were applied to the spinal root peripherally to the ganglion. There

is a slight increase in amplitude of the respiratory movements and practically no effect upon the circulation.

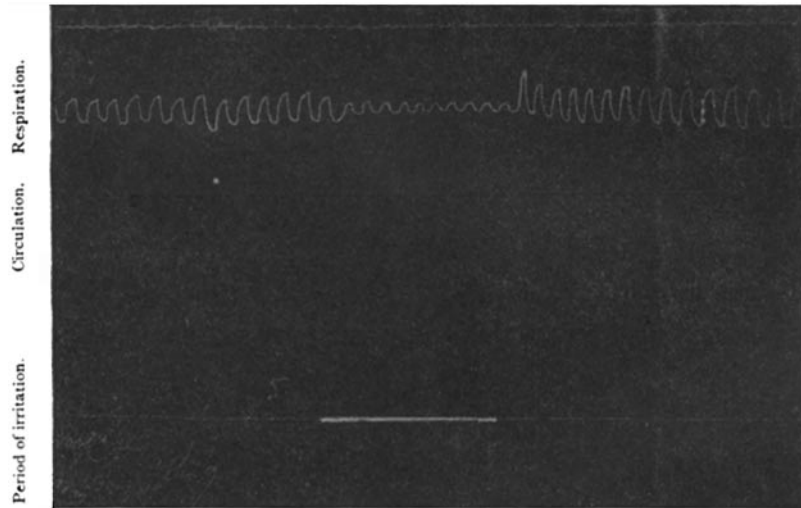


TRACING 2. Electrode applied centrally to the ganglion; anesthesia incomplete; corneal reflex present. Coils of the faradic apparatus 10 c.m. apart.



TRACING 3. Electrode applied peripherally to the spinal ganglion; complete anesthesia; no corneal reflex. Coils of faradic apparatus 5 c.m. apart.

Tracing II is a record of an experiment in which electrodes were applied centrally to the ganglion. We have here the effect noted before, namely a marked acceleration of rhythm and increase in amplitude of the respiratory movements, and a decided fall in blood pressure. These experiments show that an amount of irritation which, when applied to the posterior roots peripherally to the ganglion had produced practically no effect, when applied centrally to the ganglion was followed by marked "vaso-motor shock." A similar result was obtained in deeply narcotized animals in which the corneal reflex was absent, and where stronger stimuli were applied.



TRACING 4. Conditions are the same as with Tracing 3. Electrode applied centrally to the spinal ganglion.

Tracings III and IV are records of two experiments on the same dog in which the electrodes have been applied peripherally and centrally to the ganglion, the coils being five centimeters apart. The tracings show the same thing as before, that is, little or no effect when the electrodes are applied peripherally and marked "vaso-motor shock" when applied centrally to the ganglion.

It is believed that the registration of these phenomena will provide a valuable method for studying the functions of the spinal ganglia under various conditions. The author intends at some future time to report the results of his researches along this line.