Gallbladder Distention and the Effects of Several Drugs on Heart Rate, Respiratory Movements and Cortical Potentials in Cats with Hypothalamic Lesions*

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Abstract—The effects of chronic hypothalamic lesions and various drugs on the viscero-visceral reflexes of cats have been investigated, utilizing measurement of the bioelectrical activity of the cerebral cortex. After coagulation of the posterolateral hypothalamus the heart rate decreased by 40-60 beats per minute, but eventually it regained its initial value. The viscero-visceral reflexes from the gallbladder to the heart were preserved after the operative procedure. Chlorpromazine and atropine blocked both arousal and the cardiorespiratory response to stimulation of the gallbladder. Similar effects were produced by novocaine and pantocaine.

The anatomy of brain mechanisms of functional integration is of great interest to the brain physiologist and to those in the field of control of visceral functions. The functional state of the so-called viscero-visceral relationships seems to depend primarily on the feedback mechanisms between lower reflex centers of the spinal cord and higher integrating structures of the neuraxis up to the cerebral cortex (Bykov, 1953; Kaada, 1951; MacLean, 1949). As a model for studying viscero-visceral reflexes we used the changes in the heart rate and respiratory movements following mechanical stimulation of the gallbladder. The changes in the EEG waves were used to indicate whether the cerebral cortex was generally involved in the control of these reflexes. Surgical and pharmacologic interventions were performed to eliminate the actions of some critical brain regions responsible, at least in part, for the inhibition or facilitation of viscero-visceral reflexes acting on the heart.

A gallbladder fistula was made and coagulation of the posterolateral hypothalamus performed in each of a group of cats. The gallbladder was distended by inserting and inflating a rubber balloon. The respiratory movements were recorded by means of a strain gauge. The heart rate either was added to the EEG curves

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by a directly-writing non-integrative cardiotachometer or was determined by measuring the RR intervals of the ECG.

Immediately after onset of the distention or seconds later, a rise or a fall in the heart rate and changes in the respiratory movements, depending on the grade of distention (pressure and volume) were observed. These changes occurred during sleep as well as in the waking animal. The animal slept, upon EEG arousal it awoke behaviorally, opening the eyes and moving the legs slightly. Often the animal fell asleep again immediately after stimulation. In some instances this happened before distention of the gallbladder was released.

In examining the effect of coagulation of the posterolateral hypothalamus on viscero-visceral and viscero-cerebral reflexes, 15 cats were observed for as long as three months. When the cats become habituated to the experimental situation, under normal conditions mean cardiac frequencies were normal for each animal. After coagulation of the posterolateral hypothalamus the heart rate decreased to a value 40 to 60 beats per minute below the initial heart rate. In some animals, however, the heart rate returned to its initial values toward the end of the observation period. The viscero-visceral reflexes from the gallbladder to the heart were preserved after the operative procedure; however, they were at a lower level, because the resting frequency of the heart remained decreased for sometime. After return of the heart rate to the initial normal value, the viscero-visceral reflexes from the gallbladder to the heart were the same as before the lesion was made in the hypothalamus (the animals served as their own controls). Respiration was not impaired by the coagulation of the hypothalamus. Coagulation of the thalamus did not change the viscero-visceral reflexes from the gallbladder to the heart activity. (At the end of the experiment the animals were sacrificed and the lesions were examined histologically.)

In the second phase of the study novocaine was injected into the gallbladder in 14 of the cats. The viscero-visceral as well as the viscero-cerebral reactions could be observed, but they were less severe than in the control experiments. The same was true with respect to the motor reactions, which were present but diminished. (Similar observations were made with the introduction of pantocaine into the gallbladder.) In more than 50 per cent of the drug experiments the cats failed to show any cardiac, respiratory, or motor reactions or any changes in cortical EEG's. In some animals the observed changes were less than before the instillation of the pharmacologic substances.

In another experimental series, 2 mg/kg of body weight of chlorpromazine was injected intramuscularly. With this drug the