7449 P

Costal and Abdominal Respiratory Movements in Relation to Nervous Control of Breathing.

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Changes in body circumference associated with respiratory movements were simultaneously recorded in the dog at 6 different levels—3 costal and 3 abdominal. (Fig. 1.) Continuous registration of respiratory movements with this method showed variations in type from time to time in the same individual. Some of these changes were spontaneous; others were elicited by deliberate introduction of new variables.

Analysis of measurements on 31 female and 73 male dogs failed to show any relation between sex and mode of breathing. Comparing the magnitude of increased costal circumference with the magnitude of increased abdominal circumference 34.3% of 106 dogs were found to breathe more with the chest than with the abdomen. Using our new method of comparing costal and abdominal accommodation of air by grossly correcting for the greater costal circumference and greater length of chest 79% were found to be costal breathers. The mean ratio of costal to abdominal accommodation for all of the dogs studied was 2.15 indicating a decided predominance of costal breathing in the dog.

A shifting from a more costal or more abdominal type towards the other respective type was frequently preceded by a momentary and sporadic stretching of the extremities. At times, periodic fluctuations in respiratory movements occurred, limited to either costal or abdominal levels. These findings suggested that periodicity may be a localized phenomenon dependent on chemical sensitivity in the cord.

Great irregularities in the magnitude of respiratory excursions occurred mostly from changing inspiratory circumference. Under these conditions the expiratory circumference may remain surprisingly uniform. In some experiments the expiratory circumferences changed as well. At times the expiratory circumference of the chest showed gross fluctuations while those of the abdomen remained perfectly constant. The reverse also occurred.

The magnitude of costal and abdominal expansion in sporadic deep breaths varied out of proportion to the prevailing respiratory

movements. The deep breaths were, therefore, frequently of opposite type to the prevailing type.

Backward injection of sodium citrate into the femoral artery produced differential effects in costal and abdominal breathing. Intravenous injection of urethane inhibited costal breathing more than abdominal.

Lowered alveolar oxygen most commonly increased the circumference of the chest and abdomen at the end of expiration and decreased the intrathoracic pressure. During recovery, costal respiratory movements were inhibited more than abdominal respiratory movements. The upper costal segments were inhibited more than the lower costal segments. Upper costal apnea and abdominal hyperpnea were not uncommon during recovery. In one experiment upper costal apnea was accompanied by abdominal hyperpnea greater than the hyperpnea of the immediately preceding anoxemia. As abdominal respiratory movements diminished during recovery the costal movements increased. This unusual coordination(?) of costal and abdominal breathing led to a smooth return to normal ventilation. (Fig. 1.)

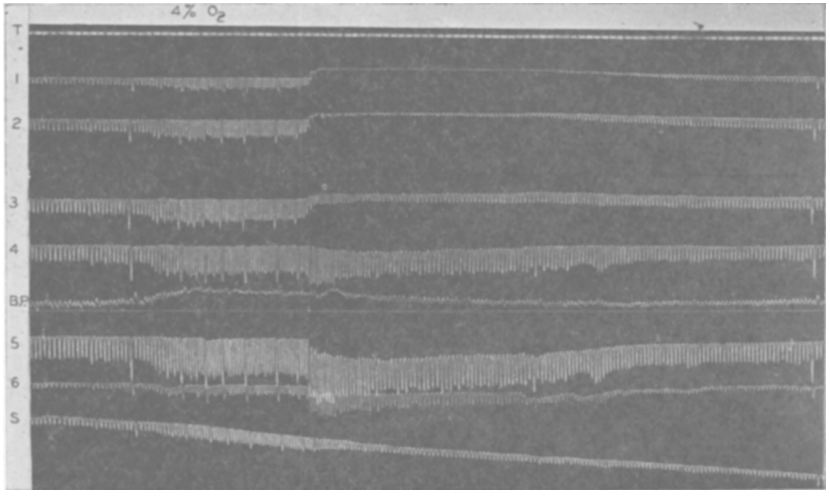

FIG. 1.

The effects of carbon dioxide differed importantly from those of anoxemia. In most experiments there was a decrease in circumference of the chest and abdomen at the end of expiration and a corresponding rise in the intrathoracic pressures.

Inasmuch as costal or abdominal breathing may shift from one to the other it is concluded that all dogs are provided with mechan-

isms permitting either type or any combination of types of breathing.

To determine whether the level of entrance in the central grey axis stem of sensory nerve impulses exerts a localized effect on breathing, such nerves as the saphenous, radio cutaneous, infra orbital and phrenic were stimulated faradically. A comparable response of accelerated breathing, decreased costal expiratory circumference and a tendency towards increased abdominal circumference was obtained in each one.

The effects of graded sensory stimulation of the mixed cervical vagus and of the pulmonary branches of the same differed considerably. These differences were attributed to the abundance of extra pulmonary nerve fibers in the cervical vagus nerve.

A strength of stimulation which will produce pure inhibition when applied during expiration may increase the depth of one introductory inspiration if applied during the phase of inspiration. The accessibility of the center to excitatory and inhibitory influences therefore varies with the phase of the respiratory cycle.

Rhythmic breathing produced by rhythmic stimulation of the cervical vagus, pulmonary branches of the vagus, and the saphenous nerve indicate that the respiratory center may become accessible to rhythmic impulses from many sources agreeing with the synchronization of breathing and rhythmic muscular movements.

Rhythmic stimulation of the vagus nerve may also produce complete respiratory inhibition. Faradic stimulation of the saphenous nerve, or chemical excitation of the carotid gland with sodium sulphide or cyanide removes the inhibition and allows the animal to breathe with each vagal stimulation. When rhythmic stimulation of the vagus nerve produces rhythmic breathing the action is, most frequently, locally selective. Costal breathing is partly or completely inhibited and abdominal breathing is usually augmented. Under these conditions cyanide or sulphide lead to powerfully augmented costal respirations and less markedly augmented addominal respirations.

A higher pulmonary ventilation is attained by cyanide during double vagal block when the vagus nerves are rhythmically stimulated, which suggests the importance of normal vagal excitation produced by inflation and deflation of the lungs.

Faradic stimulation of the saphenous nerve, and intravenous injection of sulphide or cyanide produce much greater and more rapid ventilation with the vagus nerves intact than during vagal block,

clearly indicating the great importance of the vagus nerves in the control of breathing.

These findings show the dependence of vagal function on inflowing afferent nerve impulses and further strengthen the general principle that breathing may be largely a resultant of numerous and various afferent nerve impulses.

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Reduction of Selenites and Tellurites by the Sulphydryl Group.

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The reducing effect of compounds containing the sulphydryl group has been tested with sodium selenite and with sodium tellurite as indicators. The following test solutions were prepared: Reagent (1), an acid reagent made up of 100 cc. of 2% sodium selenite or sodium tellurite plus 20 cc. concentrated hydrochloric acid; reagent (2), 2% sodium selenite or sodium tellurite solution, which is slightly alkaline; reagent (3), a more alkaline reagent containing 2% sodium selenite or sodium tellurite in 10% sodium carbonate. The compounds studied were the thio compounds, ethyl mercaptan, thioacetic acid, thioglycollic acid, thiocresol, thiourea, glutathione, cysteine hydrochloride, and the sulphur containing compounds not possessing the SH group—cystine, and thiophene.

On reduction sodium selenite yields free selenium in the form of a brick red precipitate or a red to brick red colloidal solution depending upon the intensity of the reaction and the quantity of the free element liberated. Sodium tellurite under similar conditions yields a brownish black precipitate of free tellurium or a black brown colloidal solution of this element. Compounds that reduce in the cold give more profuse reduction under the application of heat. The test is carried out by allowing 3 cc. of the compound in aqueous solution to interact with 3 cc. of the selenite or tellurite reagent. The reduction of sodium selenite or tellurite by the compounds is of special value, since the reaction is irreversible and the reduced selenium or tellurium does not display a tendency to undergo re-oxidation.