

ROLE OF THE 'ACCELERATOR' AND HERING-BREUER REFLEXES IN TEMPERATURE REGULATION IN DOGS

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Hering and Breuer (1868) discovered the reflexes arising from the lungs and found it responsible for maintaining the accelerated rhythm of respiration. Their work was confirmed later on by Head (1889) and Adrian (1933). Haldane and Priestley (1935) noted that this accelerated rhythm of respiration was out of proportion to the physiological respiratory needs of the body. The present investigation has therefore, been made to determine the functional significance of the accelerated rhythm of the respiration.

METHODS

The study was conducted on 60 dogs weighing from 2.5 to 16.25 kg. Animals of both sexes were used. They were anaesthetised with chloralose (75-80 mg/kg body weight) given intravenously. The respiration was recorded by a tambour connected to a medium sized toy balloon introduced between the liver and the diaphragm through a medium abdominal incision. The deep rectal temperature was recorded by a thermometer. The temperature of the animal was raised by the heat of the carbon bulbs from above and by warming the animal plate of the operation table on which the animal rested.

RESULTS

It was observed that when the temperature of the dogs was artificially raised there was at first a gradual rise in respiration rate, but on reaching a temperature of about 40 to 41°C the rise in respiration rate was very steep. At this temperature it was also observed that by mere opening of the mouth there was a further increase in respiration rate which fell back to the previous rate when the mouth was closed (Fig. 1). This was first noted by Mathur and Chowdhary (1952). The critical body temperature at which this reflex acceleration occurred on opening the mouth was below 40.5°C in 9 dogs, and was between 40.5°C to 41.5°C in 45 dogs, whereas in 6 animals this reflex did not appear at all. The lowest temperature at which it was observed was 37°C in 2 dogs, and 36.5°C in 1 dog. This reflex usually

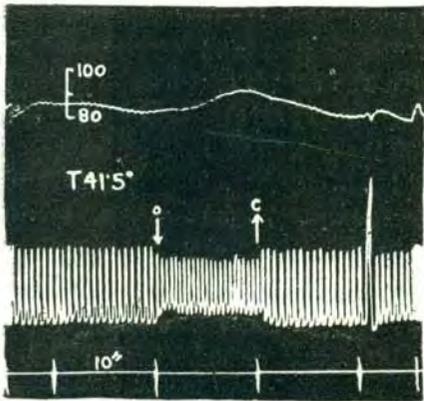


Fig. 1

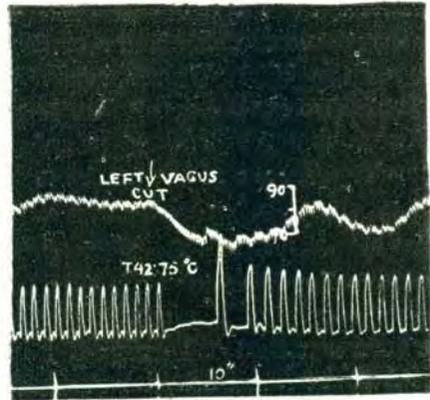


Fig. 2

The upper tracing is record of blood pressure and the middle respiration. In Figure 1 the effect of opening the mouth at O and closing it at C is shown on respiration. In Figure 2, the effect of cutting the left vagus on respiration is shown; the right vagus was cut earlier.

disappeared on reaching a temperature of 42°C, except in 4 dogs where it did not disappear even upto 43°C. This reflex has been designated as the 'accelerator reflex'. It was observed that with the onset of the 'accelerator reflex' the amplitude of respiration always decreased when the mouth was opened as compared with the observations made with mouth closed. Respirograms obtained from these dogs before and after cutting the vagi at raised body temperature showed the classical result. The respirations became relatively slow and deep on vagotomy (Fig. 2).

DISCUSSION

Dogs do not possess effective sweat glands for temperature regulation and they depend for heat loss on the pulmonary mechanism. The increase in respiration rate with the rise in body temperature is thus obviously meant for heat loss. The 'accelerator reflex' which further increases the respiration rate on opening the mouth is an additional attempt in the same direction. At the same time with the onset of the 'accelerator reflex' on opening the mouth the respirations become shallower as compared to the respirations with mouth closed. This helps in greater movements, in and out, of the dead space air without necessarily affecting the alveolar gases, and at the same time promoting evaporation of water from the respiratory passages and from the mouth.

The normal respiration in the absence of Hering-Breuer reflex is slow and deep, and that slow and deep respiration is converted into quick and

shallow respiration by Hering-Breuer reflex. In some similar way the comparatively more quick and more shallow respirations due to the opening of the mouth are superimposed over the comparatively slow and deep respiration of the Hering-Breuer mechanism when the mouth is closed. On the basis of these experiments it may further be suggested that the Hering-Breuer reflex which cuts short the depth of respiration is primarily meant for temperature regulation and not for the exchange of gases.

SUMMARY

A reflex in which there is acceleration of the rate of respiration in dogs on opening the mouth and its return to the original rate on closing it has been described and designated as the 'accelerator reflex'. This reflex was found at raised body temperatures only.

A similarity between this 'accelerator reflex' and the accelerator Hering-Breuer reflex has been pointed out. It is suggested that both serve the same purpose of heat loss in these animals.

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