

呼吸周期に関連するラットの迷走神経求心性活動

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NOTE

Vagal Afferent Activities Corresponding to Respiratory Cycle in Rats

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The single action potential was recorded to determine the pattern of spontaneous vagal afferent activity corresponding to the respiratory cycle of rats. According to either the adaptability or the responsiveness of the discharge to the respiratory cycle, the vagal afferents were classified into 5 categories. One group of the afferents discharged constantly and continuously as long as the lung deflation continued. Such activity has been reported only in rabbits.—*Key words:* Respiratory cycle of rats, Vagal afferent.

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Three types of vagal sensory receptors, the pulmonary stretch receptor, the lung irritant receptor and type J receptor, are known in the lung of cats (1–3), dogs (4, 5), and rabbits (6–8). These lung receptors show various responses to the respiratory movement and to pathological changes in the lung (9), which induce many kinds of the reflex action on the cardiopulmonary function. Little has been reported on the lung receptor activities in the rat, though this species has widely been used for the experiments investigating the toxicity of inhaled agents.

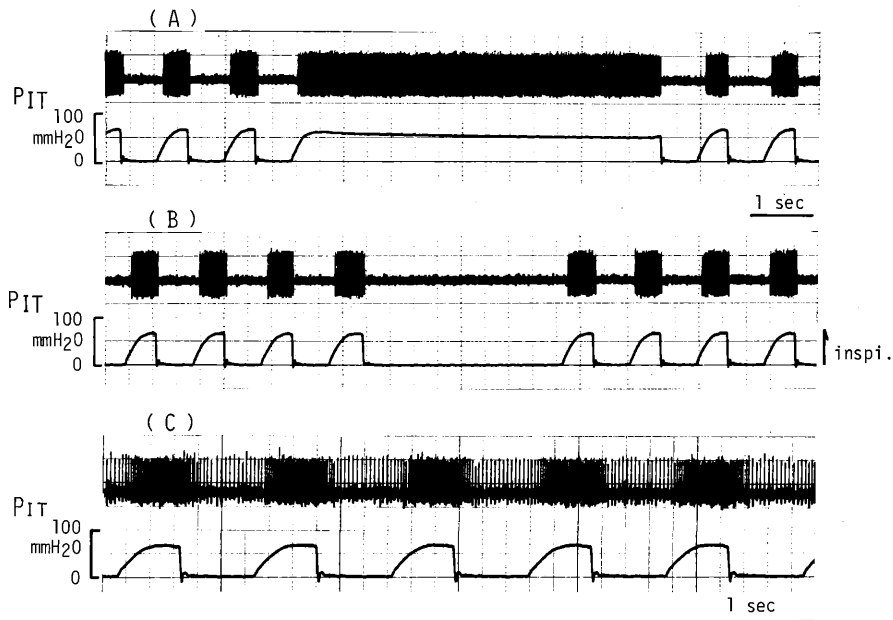
This paper describes the pattern of vagal afferent activities corresponding to the respiratory cycle in the rat by recording the spontaneous discharges.

Forty-three Wistar-strain rats weighing from 320 to 450 g were anesthetized with a mixture of urethane (0.6 g/kg) and α -chloralose (40 mg/kg) intraperitoneally injected, and they were further treated with gallamine triethiodide (20 mg/kg i.v.) under artificial ventilation to block their spontaneous respiration. The ventilation was carried out 60 times per min through a tracheal cannula connected to a respirator. The intratracheal pressure (P_{IT}) and the tidal volume

were kept at 70 mmH₂O, and 1.3 to 1.6 ml for each inspiration.

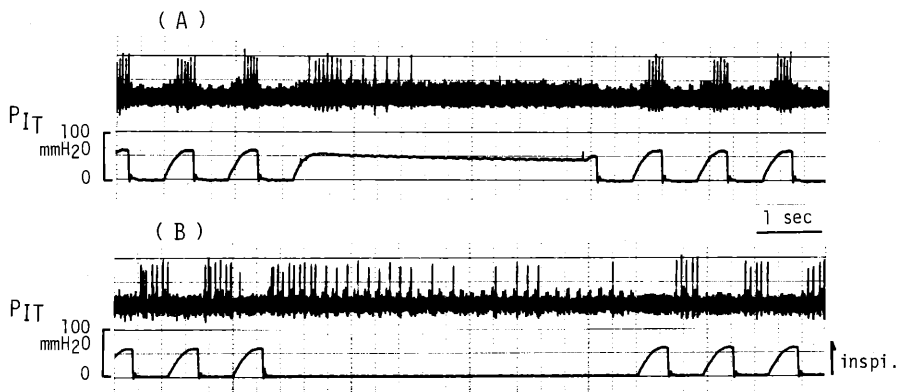
The cervical vagus nerves were transected bilaterally at the rostral side and the peripheral end of the separated left vagus was introduced into a small box filled with paraffin oil warmed to 35 to 37°C. The fine strand separated from the vagus was mounted on platinum bipolar electrodes, and the single activities were amplified with a low noise input box (DIA MEDICAL, DPA201) and with a biophysical amplifier (DIA MEDICAL, DPA100F). The intratracheal pressure (P_{IT}) was detected by a transducer (Toyoda, PD104K). The amplified nerve potentials and P_{IT} were monitored with a 4ch Braun-tude oscilloscope (National, VP5403A) and were memorized into a magnetic tape recorder (TEAC, R-270A). The nerve responses during inflation or deflation of the lung were recorded after the single action potentials showed a constant pattern according to the respiratory cycle.

Figs. 1–3 show five different patterns of afferent activities which observed with a certain correlation to the respiratory cycle. Fig. 1-A, B show a fiber in which high frequency impulses were recorded only during inspira-



A and B were recorded from the same fiber and C was from a different fiber. Upward deflection in the intratracheal pressure (PIT) shows the inspiration or the lung inflation. S.A.: spontaneous activity.

Fig. 1. Spontaneous activities of a fiber from the pulmonary stretch receptor and its responses to the maintenance of the inflation(A) and deflation(B) of the lung.

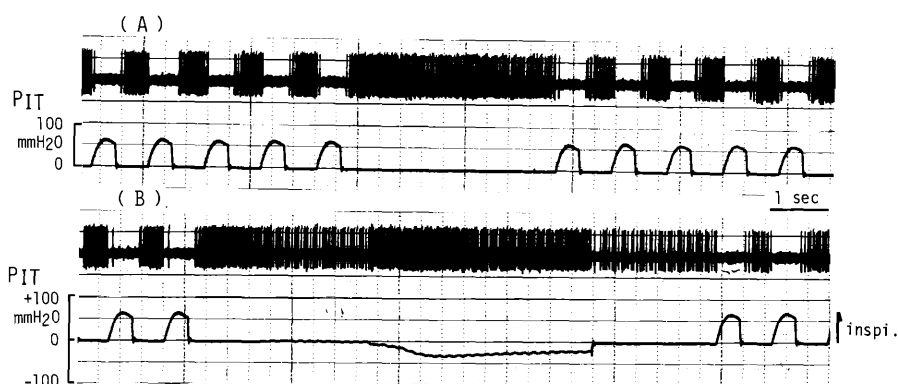


A and B were recorded from the same fiber. Abbreviations are the same as in Fig. 1.

Fig. 2. Discharge patterns of two fibers showing rapid adaptability to the maintenance of inflation(A) or deflation(B) of the lung.

tion; the peak frequency resided at the maximum of inspiration. When the lung inflation was extended to 4 to 6 seconds, the occurrence of the high frequency was prolonged (Fig. 1-A). This fiber ceased discharge as long as the lung deflation continued (Fig.

1-B). The fiber of this type was thought as the pulmonary stretch receptors observed in cats (2, 10). Fig. 1-C show a fiber in which impulses were continuously observed. The frequency during expiration was less than that during inspiration. This kind of activity pat-



A and B were recorded from the same fiber. Abbreviations are the same as in Fig. 1.
 Fig. 3. Discharge patterns of a fiber activated during deflation(A) and forced large deflation(B) of the lung.

tern has been recognized as the low-threshold pulmonary stretch receptors in cats (11). In Fig. 2, the nerve activities with a small number of impulses during either period of inspiration (A) or expiration (B) were shown. In such fibers, the impulses rapidly disappeared if the period of inflation (Fig. 2-A) or deflation was extended (Fig. 2-B), suggesting the fast adaptability. These activities resembled the rapidly adapting tracheal or pulmonary stretch receptor such as the cough receptor in the trachea or the irritant receptor in the lung (2, 3).

Another fiber activity was observed and shown in Fig. 3. This fiber discharged constantly during expiration, but never during inspiration. The activity of this fiber consisted of 2 to 6 closely grouped impulses and the impulse frequencies varied from 10 to 40 in each expiration period. The frequency seemed to be modified by the heart beat. When the large deflation was forced, the impulses increased further (Fig. 3-B). The discharge pattern particularly during the forced large deflation indicated the slow adaptability of this fiber. This fiber could be identified as the Luck's expiratory receptors (8) reported in rabbits. As regards this receptor, Paintal (9) described that this receptor was presumably identical with the lung irri-

tant receptors, whereas precise studies concerning the difference between the Luck's expiratory receptors and the lung irritant receptors have not been performed.

From the present study, it was indicated that the vagal afferent in rats include fibers which showed different activities according to inspiration and expiration. More investigations in detail will establish the localization of the endings of these fibers and clarify their reflex responses to various mechanical and chemical irritations loaded on the lung.

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要 約

呼吸周期に関連するラットの迷走神経求心性活動(短報): 局 博一・鈴木 明 (国立公害研究所環境生理部) —— ラットの迷走神経求心性線維から人工呼吸下で自発放電を記録することにより, 放電と呼吸周期との相互関係および肺の収縮, 拡張に対する応答様式を明らかにした。吸息時にのみ安定して放電する線維, 吸息時と呼息時に連続して放電する線維, 呼息時にのみ安定して放電し, かつ肺の強制的な収縮に対して鋭敏に応答する線維, 吸息時または呼息時に少数の放電を行い, 急速に順応する線維が見出された。これらのうち呼息時に安定して放電する線維はこれまで, 兎でのみ報告されているものであった。