Activity of lumbar spinal neurons was recorded extracellularly during late long-lasting discharges in efferent nerves in immobilized thalamic cats. Of the total number of cells tested, 70% changed their activity during late discharges. The activity of 35% of neurons was increased during late discharges in nerves to flexors, but inhibited during discharges in nerves to extensors. Responses of 27% of neurons were of the opposite character. Other neurons were found whose activity was increased (5%) and reduced (3%), respectively, during later discharges in both flexor and extensor nerves. Most interneurons which changed their activity during late discharges were located in lateral parts of the intermediate zone of gray matter and the ventral horn at a depth of 2.8 mm. The character of the afferent input to a neuron was found to depend on the late efferent discharges and activity of the neurons correlated with them. Neurons whose activity was unchanged during late discharges (30%) were mainly located rather more dorsally, at a depth of about 2.0 mm. The possible mechanisms of the participation of these groups of interneurons in the generation of late discharges are discussed.

INTRODUCTION

In order to understand the mechanisms of function of the spinal locomotor generator, information is required on the types and characteristics of activity of its component neurons. Unfortunately there is at present virtually no such information in the literature. All that is known is that neurons activated during late [8, 10] or rhythmic discharges [4] in motor nerves of immobilized spinal cats are located mainly in the lateral parts of the intermediate zone of gray matter and ventral horn. It is in these regions that the largest number of neurons modulated during locomotion of a mesencephalic cat with deafferented hind limbs on a treadmill is found [2]. However, in the investigations cited no steps were taken to identify the neurons tested with regard to the character of their afferent inputs. The only exceptions from this point of view are studies of activity of Ia interneurons during late [6] and rhythmic [4] discharges in motor nerves in spinal cats and also during locomotion in mesencephalic cats [5].

The present writers showed previously [1] that stimulation of flexor reflex afferents (FRA) in thalamic cats, just as in spinal cats (after administration of Dopa), evokes late long-lasting discharges in efferent nerves. In the present investigation activity of lumbar spinal neurons was studied during late discharges in motor nerves in thalamic cats. Special attention was paid to identification of the neurons.

EXPERIMENTAL METHOD

Experiments were carried out on 22 adult cats. The preparatory operation on the animals was performed under ether anesthesia. To record efferent activity, nerves to the following hind-limb muscles were dissected: m. tibialis anterior (T. ant.), m. extensor digitorum longus (Edl), m. gastrocnemius medialis (Gm), m. flexor digitorum longus (Fdl). To identify the nerve to be tested, n. suralis, n. peroneus superficialis, the remaining parts of n. peroneus profundus and n. tibialis, and also nerves to m. quadriceps, m. posterior biceps and m. semitendinosus, m. anterior biceps and m. semimembranosus, and m. gastrocnemius lateralis were dissected on the side of recording. In the contralateral limb, m. peroneus communis and n. tibialis were dissected.
Activity of interneurons was recorded extracellularly in segments L6 and L7 by means of platinized glass microelectrodes filled with Wood's alloy. To detect neurons without spontaneous activity, the microelectrode was inserted during repetitive stimulation of peripheral nerves.

EXPERIMENTAL RESULTS

In this investigation, just as previously [1], late discharges (with a latent period of 40 to 200 msec) were evoked in motor nerves by stimulation of ipsilateral or contralateral FRA. During stimulation of ipsilateral FRA late discharges appeared in flexor nerves. Contralateral stimulation of FRA, on the other hand, was accompanied by the appearance of late activity in either extensor or flexor nerves.

Activity of 240 spinal neurons was studied during late discharges. Depending on the character of their activity during late discharges, all the cells tested could be divided into the following groups.

Group A (n = 84). The level of activity of the neurons of this group increased on the appearance of late discharges in the flexor nerves and decreased or remained unchanged (compared with the resting state) during late discharges in extensor nerves. Definite correlation was found between the time course of the late discharge in the flexor nerve and the time course of the change in unit activity (Fig. 1).

Group B (n = 65). This group included neurons whose activity was reduced on the appearance of late discharges in the flexor nerves and increased during late discharges in extensor nerves. Examples of the activity of this group of neurons are given in Fig. 2.