Receptors in focal reflex myoclonus

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SYNOPSIS The findings in a patient with focal reflex or action myoclonus suggest that the cortical somatosensory evoked response and the long loop reflex of the finger flexor muscles evoked by extension of the index finger at the volar surface of the distal phalanx occur largely through stimulation of touch or pressure receptors with evidence of a lesser contribution by joint receptors or muscle stretch receptors. Touch or pressure in the absence of movement is an adequate stimulus, whereas muscle stretch by itself is not.

In a recent study of a patient with focal reflex or action myoclonus, involving the right side of the body predominantly, it was pointed out that the huge somatosensory evoked response (SER) and the long loop reflex recorded from thenar muscles could be evoked by stimulation of the right median nerve, either mixed nerve at the wrist or sensory nerve at the digits (Sutton and Mayer, 1974). It was apparent, therefore, that stimulation of muscle afferent nerve fibres is not essential for this response. Further studies in this patient have investigated the relative contributions of touch or pressure, joint, and muscle stretch responses to the SER and long loop reflex, and are here presented.

METHODS

The SER and long loop reflex were evoked by two kinds of stimuli separately. Electrical stimuli were delivered to the distal phalanx and just proximal to the distal interphalangeal joint of the right middle finger through silver ring electrodes. A stretch stimulus was applied to the right flexor digitorum sublimis and profundus muscles of the index finger with a slight initial stretch and with the hand in the position of function (Lundberg and Winsbury, 1960). This was accomplished with a vibrator (Electrodyne AV-2) and lever arrangement such that the volar surface of the distal phalanx of the right index finger resting on a metal rod 1 mm in diameter was elevated about 1 cm, thereby extending this digit (reaching a peak after approximately 8 ms in Fig. 2) for a period

slightly longer than the time of analysis (200 or 500 ms).

The SER was recorded over the cerebral hemisphere contralateral to the stimulated hand with one gold surface electrode 2 cm posterior to the vertex and 7 cm lateral to the midline and the other electrode on the ear. Surface gold electrodes were placed over the right forearm flexor muscles so as to record the long loop reflex of the flexor digitorum sublimis and profundus. For both the SER and long loop reflex 20 or 32 responses separated by intervals of five or 10 seconds were averaged with a computer (Neuro-Data AR-2300).

Two techniques were used to dissect out the contribution of different receptors to the SER and the long loop reflex. The relative contribution of touch or pressure versus joint or stretch receptors to the SER and long loop reflex was assessed by recording both during repetitive extension of the right index finger and after immobilization of this digit. Secondly, to eliminate the contribution of touch or pressure, and of joint receptors of the hand and yet to preserve the contribution of muscle afferent nerve fibres of the flexor digitorum sublimis and profundus muscles, an infant blood pressure cuff was inflated at the wrist to produce pressure block of the nerve to the right hand during repetitive extension of the right index finger. Sufficient anaesthesia of the hand was considered to exist upon disappearance of the SER evoked by electrical stimulation of the right middle finger.

RESULTS

The first technique demonstrated a decrease in the amplitude of the responses after immobiliza-

FIG. 1 Recording of the SER (upper trace) and the long loop reflex (lower trace) (A) before, and (B) after immobilization of right index finger. An upward deflection in the SER trace and a downward deflection in the EMG trace represent positivity at the active electrode. Thirty-two extensor stimuli were delivered to the right index finger with onset 22 ms after the start of the traces and reaching a peak about 8 ms later. The analysis time is 200 ms. Calibration: upper trace = 50 μ V and lower trace = 1 mV. Time line = 100 ms.

FIG. 2 Recording of the SER (upper trace) and the long loop reflex (lower trace) as in Fig. 1, (A) before, and (B) one and one-half hours after applying a wrist cuff. Calibration: upper trace = 50 μ V and lower trace = 1 mV. Time line = 100 ms.

tion of the right index finger varying from slight up to a maximum of one-fourth for the SER and one-half for the long loop reflex (Fig. 1). Within two hours after application of the wrist cuff as

described in the second technique there was a gradual concurrent attenuation and eventual disappearance of the SER and long loop reflex both to electrical stimulation of the middle finger and to extension of the index finger of the right hand (Fig. 2).

DISCUSSION

In a recent paper Marsden *et al.* (1973) seek to extend the traditional view of the muscle stretch reflex—that is, a segmental spinal reflex—to include a transcortical pathway in which the stimulus is passive movement of a joint and in which the response is muscle resistance at that joint. This concept is based largely upon their findings that (1) the latencies of the reflexes of the masseter, and long flexor muscles of the thumb and big toe (evoked by movement at the appropriate joint at rates of about 200°/s and recorded as electromyographic activity) being sufficiently long to traverse a transcortical pathway, and (2) the homolateral absence of this reflex in the long flexor of the thumb in a patient with clinical evidence of an unilateral dorsal column lesion. These authors state that 'such a transcortical stretch reflex derives its recent plausibility from the discovery that impulses from muscle stretch receptors (muscle spindles) have a rapid pathway to the cerebral cortex'. However, the authors themselves present evidence which argues against the concept that stretch receptors are the significant receptors in a pathway which includes the cerebral cortex. They report that after anaesthesia of either the thumb or whole hand, such that the spindles of the long flexor muscle of the thumb are not involved, there is loss of the reflex to passive movement of this muscle. They conclude that 'somatic sensation (from the skin or elsewhere) is heavily involved in the healthy human stretch-reflex pathway'. Marsden *et al.* (1973) provide evidence that the normal long-latency response to passive joint movement is affected by fatigue and load when the range of joint movement and cutaneous stimulation were kept constant, so the evidence on anaesthesia may not contradict the notion that spindle receptors may contribute to the response, which may effectively be 'gated' by cutaneous or joint input.

It should be emphasized that the response to

passive movement is not synonymous with the stretch reflex, which is a response generated by discharge of muscle spindles. The usual clinical manoeuvres used in eliciting response to passive movement necessarily involve stimulation of tactile and joint receptors as well as muscle spindles. This might well set up long loop reflex responses or facilitation of alpha motoneurons.

Marsden *et al.* (1973) further suggest that 'in certain patients with myoclonus epilepsy, of the variety in which jerks can be provoked by sensory stimuli, the myoclonic jerks are, really deranged cortical stretch reflexes', since muscle stretch is the essential stimulus. However, there are different kinds of myoclonus and, as shown in this study of a patient with focal reflex myoclonus, muscle stretch of the flexors of the index finger is neither the essential or the most significant stimulus in evoking the SER and long loop reflex. Instead, the results suggest that touch or pressure are the most significant stimuli and to a lesser degree joint movement or muscle stretch.

This is supported by the work of Phillips *et al.* (1971). On the basis of the absence of any early responses in cortical area 4 to weak muscle-nerve stimulation, the presence of unequivocal responses in area 3a, and the lack of any evidence of corticospinal neurones in area 3a by antidromic stimulation of the dorsolateral funiculus at about the C3 spinal segment they deduce

that the possibility 'of a dense three-neurone pathway leading from spindle primaries to the baboon's motor hand area, and forming the afferent limb of a transcortical loop can now be ruled out'. Wiesendanger (1973) further concludes that 'the original hypothesis of a load compensating pyramidal reflex with an oligo-synaptic afferent contribution from the spindle primaries can be discarded' and that 'there is a feed-back from secondary muscle spindle afferents which, by way of a more complex pathway, can modulate the firing frequency of neurones in the motor cortex'.

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