Crossed Reflex Actions by Low Threshold Muscle Afferents

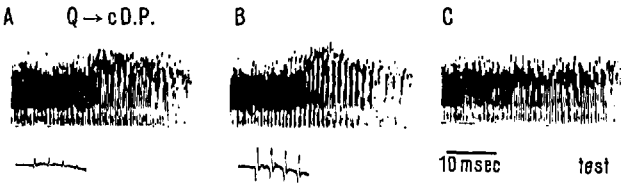
A number of crossed spinal reflex actions are known to exist[1] but there have been few attempts to analyse them in terms of the contributions from various somatic afferent systems. Crossed effects by volleys in high threshold muscle afferents have been reported[2] and PERL has described certain actions by single volleys in the large muscle afferents (group I)[3]. He found that a group I volley from knee flexors or extensors evokes inhibition followed by facilitation in motoneurones of corresponding contralateral muscles and, less consistently, a reciprocal pattern in motoneurones of their antagonists. Crossed effects on adequate activations of muscle receptors were assumed to be mediated by group I afferents[4].

Cats made spinal by high lumbar section about two weeks before the final experiment, were used in the present investigation, because it was found that crossed actions from low threshold afferents were easiest elicited in these preparations. Even so, single conditioning maximal group I volleys hardly ever influenced contralateral monosynaptic test reflexes (whereas volleys in high threshold muscle afferents had pronounced effects). On the other hand, if a train of conditioning volleys were given, considerable contralateral group I effects were observed. This is illustrated in the Figure where the monosynaptic test reflex from the DP (deep peroneal = *tibialis anterior* + *extensor digitorum longus*) nerve is conditioned by a train of group I volleys from the contralateral quadriceps nerve. Each record consists of many (about 150) superimposed traces of monosynaptic reflex discharges scattered across the screen, while the conditioning stimuli are given at a fixed interval after the sweep start. The unconditioned monosynaptic test discharge is shown alone in record C. A clearcut crossed action appears already at a stimulus strength of 1.7 times threshold (A) and the action increases when the stimulus strength is raised to 2.75 times threshold (B), which is just submaximal group I. In excitable preparations, it was often sufficient to use two conditioning volleys to evoke crossed actions, otherwise 3–6 were needed. By increasing the number of conditioning stimuli the effect increased markedly. On repetitive stimulation at constant strength the successive volleys gradually decreased. When high range group I stimulation was used, monophasic recording of the incoming volley from dissected dorsal root-filaments was often made afterwards; and it was proved that the effects observed were evoked at stimulus strengths subliminal to group II fibres. In special control experiments it was established that at frequencies used there was no temporal summation of subthreshold stimuli in group II fibres, in other words a train of stimuli did not activate fibres not activated by the first stimulus.

In the Figure it should also be noted that a stimulus activating only about one fifth of the group I fibres was sufficient to evoke crossed actions (A). Such low threshold activation was also frequently observed between extensors. The stimulus strength was regularly increased with fine gradations which resulted merely in an increased effect. There was never any evidence of dual crossed group I actions (cf. Figure where records A and B are chosen from a series with increasing stimulus strength).

The most striking and constant feature of the crossed group I pattern is the prominent excitatory action between extensors (*quadriceps, gastrocnemius-soleus, plantaris* and *flexor digitorum longus*). There was never any inhibitory action from extensors to any contralateral extensor nucleus. From flexors investigated, facilitation was found from DP to contralateral extensor nuclei, while BSt (*posterior biceps-semitendinosus*) seldom evoked any group I effect, but inhibition was observed once to quadriceps.

As regards the receptiveness of flexor nuclei, there were differences between BSt and DP. Group I volleys from extensors usually facilitated DP, whereas actions to BSt were less frequent. Between flexors group I, facilitation from DP to DP was observed but never any effect from BSt to BSt.



Upper records consist of superimposed traces of many monosynaptic reflex discharges evoked from the nerve to the deep peroneal muscles (*tibialis anterior* + *extensor digitorum longus*) and recorded in the ventral root. At each sweep the reflex discharge is automatically delayed so as to traverse the screen and this procedure is repeated 4 times. The distribution of reflex discharges is not uniform, the density decreases in the end of the record. The unconditioned test reflexes are shown in C, and in A and B the actions of a train of conditioning volleys from the contralateral quadriceps nerve evoked at a stimulus strength of 1.7 respectively 2.75 times threshold for the nerve. Lower traces show the conditioning volleys from the quadriceps nerve recorded in the dorsal root entry zone.

To summarize. The use of repetitive stimulation has proved valuable for disclosing crossed group I connections and a description of their pattern has been given. On the other hand, with repetitive stimulation it is more difficult to separate contributions from the fast and slow component of the group I volley, and so far it has not been possible to differentiate conclusively between actions evoked from large muscle spindle afferents and Golgi tendon organ afferents.

Zusammenfassung. Bei chronisch spinalen Katzen wurde mit Hilfe tetanischer Reizung festgestellt, dass grosse afferente, von Muskeln kommende Fasern gekreuzte Wirkungen auf monosynaptische Reflexe ausüben. Die Ausdehnung der Effekte wird beschrieben.

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On the Mechanism of Increasing the Tuberculostatic Activity of Isoniazid in the Presence of 4-Aminobenzoic Acid

We have shown in previous communications[1,2] that 4-aminobenzoic acid (PABA) increased *in vitro* the bacteriotropic activity of isoniazid on *M. tuberculosis*, whereas 2-aminobenzoic acid exerted an exactly opposite influence[3].

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