Abstract We investigated the time course of changes in motor cortex excitability after median nerve and digit stimulation. Although previous studies showed periods of increased and decreased corticospinal excitability following nerve stimulation, changes in cortical excitability beyond 200 ms after peripheral nerve stimulation have not been reported. Magnetoencephalographic studies have shown an increase in the 20-Hz rolandic rhythm from 200 to 1000 ms after median nerve stimulation. We tested the hypothesis that this increase is associated with reduced motor cortex excitability. The right or left median nerve was stimulated and transcranial magnetic stimulation (TMS) was applied to left motor cortex at different conditioning-test (C-T) intervals. Motor-evoked potentials (MEPs) were recorded from the right abductor pollicis brevis (APB), first dorsal interosseous (FDI), and extensor carpi radialis (ECR) muscles. Right median nerve stimulation reduced test MEP amplitude at C-T intervals from 400 to 1000 ms for APB, at C-T intervals from 200 to 1000 ms for FDI, and at C-T intervals of 200 and 600 ms for ECR, but had no effect on FDI F-wave amplitude at a C-T interval of 200 ms. Left median nerve (ipsilateral to TMS) stimulation resulted in less inhibition than right median nerve stimulation, but test MEP amplitude was significantly reduced at a C-T interval of 200 ms for all three muscles. Digit stimulation also reduced test MEP amplitude at C-T intervals of 200–600 ms. The time course for decreased motor cortex excitability following median nerve stimulation corresponds well to rebound of the 20-Hz cortical rhythm and supports the hypothesis that this increased power represents cortical deactivation.

Key words Motor cortex · Magnetic stimulation · Excitability · Nerve stimulation · Cortical rhythm

Introduction

Activity of pyramidal tract neurons in the primate motor cortex changes in response to peripheral stimulation (Evarts 1973; Wiesendanger 1973; Porter and Rack 1976). In humans, there are periods of increased (Deuschl et al. 1991; Rossini et al. 1991; Deletis et al. 1992; Komori et al. 1992; Maertens de Noordhout et al. 1992; Hirashima and Yokota 1997) and decreased (Mariorenzi et al. 1991; Rossini et al. 1991; Maertens de Noordhout et al. 1992; Clouston et al. 1995; Inghilleri et al. 1995; Hirashima and Yokota 1997; Manganotti et al. 1997) corticospinal excitability in the first 100–200 ms following median nerve or digit stimulation. Changes in motor cortex excitability beyond 200 ms after peripheral nerve stimulation have not been reported.

Electrocorticographic (Jasper and Penfield 1949; Gastaut et al. 1952), magnetoencephalographic (MEG) (Salmelin and Hari 1994; Salmelin et al. 1995; Salenius et al. 1997a) and electroencephalographic (EEG) (Pfurtscheller et al. 1996) studies have suggested that the rolandic rhythm consists of 10-Hz and 20-Hz components, and the 10-Hz rhythm is mainly generated in the somatosensory cortex while the 20-Hz rhythm predominantly arises from the motor cortex. Median nerve stimulation leads to an immediate decrease in the 20-Hz rolandic MEG rhythm (event-related desynchronization, ERD), followed by increased activity above the baseline level (event-related synchronization, ERS) at 200–1000 ms after the stimulus (Salmelin and Hari 1994; Salenius et al. 1997b; Schnitzler et al. 1997). The rebound in 20-Hz activity following median nerve stimulation is decreased by activation of the motor cortex with voluntary movement, motor imagery or