Spinal Reflexes in Microgravity: Measuring H Reflexes During Space Flight

In the special issue of *Science* devoted to the results from Spacelab 1 (13 July 1984) the report by M. F. Reschke *et al.* (*1*) addresses the problem of motor programming in microgravity by measuring Hoffman or H reflexes in man during space flights. Before and after the flight, control changes of these reflexes were measured during falling under the influence of gravity. During the space flight, changes were measured during falling induced by rubber bands. The magnitude of the changes recorded cannot be easily understood since the intensity of the stimuli to evoke the reflexes is not specified and since the changes are extremely high.

The authors refer to the paper by Hugon (*2*) in which standard techniques for H reflex studies are described but no procedures to normalize H reflexes modulated by various conditions are suggested. It is proposed, however, in another paper (*3*) of which Hugon is coauthor that it is useful to choose a stimulus intensity such that, when evaluating inhibitory and facilitatory effects on the H reflex, the test H reflex is about half the amplitude of the maximum H reflex recorded under identical conditions. The authors emphasize that stimulus strengths should be specified in any published reports.

Let us assume that Reschke *et al.* applied electrical stimuli that in the control situation elicited H reflexes of half the maximum amplitude. The size of the maximum H reflex is 52 percent (obtained from 52 recruitment curves) of the maximum M response (*2*). Since a maximum M response is obtained with electrical stimuli that excite all motor fibers, it is impossible to record H reflexes that are larger than the maximum M response, even with large facilitatory effects. The maximum facilitation can thus not exceed 285 percent of the control reflex.

There are two possibilities that may explain the facilitations of up to 4000 percent found by Reschke and his colleagues:

1) The values are, by mistake, too large by a factor of 100. Facilitatory effects of about 40 percent are well within the range we have obtained in a reaction time task (*4*).

2) Reschke and his colleagues used stimuli of low intensity. If the maximum facilitation were 4000 percent, control reflexes would have to be 2.5 percent of the maximum M response. Based on my own experience, it seems to be unwise to use control reflexes of such a small amplitude as the variability because variations of electrode position and spontaneous changes in motoneuronal excitability (*5*) exceed by far 2.5 percent.

D. G. RÜEGG
Institute of Physiology, University of Fribourg, CH-1700 Fribourg, Switzerland

References and Notes

1. M. F. Reschke, D. J. Anderson, J. L. Homick, *Science* **225**, 212 (1984).
2. M. Hugon, in *New Developments in Electromyography and Clinical Neurophysiology*, J. E. Desmedt, Ed. (Karger, Basel, 1973), vol. 3, pp. 277–293.
3. C. H. M. Brunia *et al.*, in *New Developments in Electromyography and Clinical Neurophysiology*, J. E. Desmedt, Ed. (Karger, Basel, 1973), vol. 3, pp. 773–780.
4. A. Eichenberger and D. G. Rüegg, *J. Physiol. (London)* **347**, 545 (1984).
5. C. C. Hunt, *J. Gen. Physiol.* **38**, 801 (1955).

26 September 1984; accepted 17 May 1985

Rüegg (*1*) is correct when he states that it is necessary to use an electrical stimulus such that the control Hoffman or H reflex is approximately half of the maximum H reflex recorded under identical conditions for evaluating either inhibitory or facilitatory effects on the H reflex. This method was used, as specified in reference 5 of our report (*2*).

Rüegg is also correct in his calculations when he reports that the maximum facilitation cannot exceed 285 percent on the basis of an H reflex recruitment curve where the maximum H response is 52 percent of the maximum M wave. However, a recruitment curve with these parameters is specific to select individuals and is frequently obtained only under ideal conditions with the subject typically in a supine position, the knee flexed and the foot slightly dorsoflexed. In the operational environment in which we worked, recruitment curves were obtained in the standing and hanging (preparation for a vertical drop) positions. In the standing position the maximum H reflex was approximately 20 percent of the maximum M wave, and in the hanging position the H reflex was typically 5 to 10 percent of the maximum M wave. In the 5 percent case this would permit a 3900 percent H reflex facilitation.

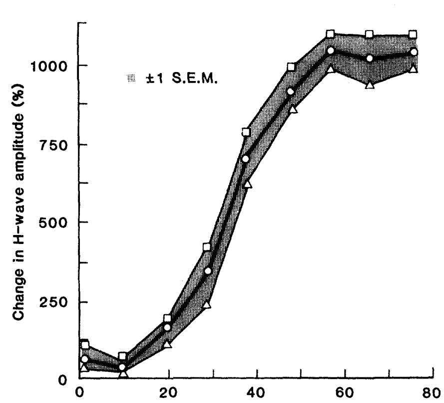

Fig. 1. Change in preflight Hoffmann reflex amplitude from subject A as a function of delay time.

Variability in the data because of the low H wave amplitudes was considerably less than we expected and, because of the large differences observed between preflight, in-flight, and postflight measurements, an even larger variance within a test day would not have obscured the main effects. Also, as Rüegg notes, variability is largely influenced by electrode position. To avoid this, we placed our electrodes at predetermined and tattooed locations (*2*). Figure 1 shows the preflight drop-to-shock curve obtained from subject A, whose drop-to-shock delay times were plotted as a function of test day in our report (*2*). This preflight curve represents the average of five test days with 20 responses at each drop-to-shock delay time and indicates the variability of the response expressed as ±1 standard error of the mean. Note the variability increases as both drop-to-shock delay and facilitation increase. This is to be expected and also demonstrates the stability of the response at the lower values of drop-to-shock delay (10 to 20 msec), confirming, as did the constant M wave response at all delays, that electrode position and stimulus current were well controlled.

In summary, the values we reported were not the result of a mistake, nor were they too large by a factor of 100. Rather, they were the result of the effects of space flight and the necessity for using a low H wave amplitude as a control. The variability of responses was extremely low even though small H wave amplitudes were used. The experimental control, test-to-test placement of electrodes, and well-trained subjects were largely responsible for the low variance.

MILLARD F. RESCHKE
Space Biomedical Research Institute, NASA–Johnson Space Center, Houston, Texas 77058

References and Notes

1. D. G. Rüegg, *Science* **229**, 1409 (1985).
2. M. F. Reschke, D. J. Anderson, J. L. Homick, *ibid.* **225**, 212 (1984).

21 November 1984; accepted 13 August 1985