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6393

The Spinal Rabbit and Its Reflexes.*

J. C. HINSEY AND C. C. CUTTING.

From the Department of Anatomy, Stanford University.

Fifteen rabbits have been transected in the lower thoracic region and have been kept from 3 to 17 days. They ate rolled barley and lettuce and drank water in a normal manner. They defecated and urinated but it was found necessary to evacuate the bladder by pressure upon the abdomen to prevent excessive retention. Trophic disturbances were avoided by keeping the animals and cages clean.

They were observed from day to day for ipsilateral and crossed reflexes in the hind limbs. Ipsiflexion, crossed flexion and occasionally crossed extension were present 24 hours after transection. Crossed extension, however, did not usually appear till about the third day and sometimes later. At first it consisted of extension at the knee and flexion at the ankle and toes. This usually changed to extension at all joints. The Stütz positive reflex became well-developed about the third day. Rhythmic stepping and hopping did not usually appear till after 4 days and they became more pronounced and greater in amplitude from day to day. In the same animal, it was possible to elicit hopping at one time, then after a short interval stepping would be present. Some of these animals were able to support their weight in the standing position but this was more poorly developed than in the cat. In the rabbit, there is considerable resistance to passive flexion in certain positions which is not due to muscle contraction for it can be obtained in the dead animal.

It was possible to anesthetize with ether, then to dissect and isolate the gastrocnemius and anterior tibial muscles. The animal was then placed in a frame and the muscles prepared for recording reflex responses according to the method we have described.¹ It was then

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allowed to recover from the anesthetic for about one hour before kymographic tracings of its responses were made. Thus it was possible to record the responses in an unanesthetized animal which was not at all disturbed by the procedure; in fact at times they ate carrots and lettuce during the progress of the experiment. The reflexes in these muscles were elicited by normal stimulation to the ipsilateral and contralateral limbs, and also by electrical stimulation of isolated nerves.

As a whole, the spinal reflex patterns in the rabbit resemble those in the spinal cat (Ranson and Hinsey,² Hinsey, Ranson and Doles,³ and Hinsey and Cutting¹). However, ipsilateral extension was much more highly developed and more regularly obtainable in the rabbit than in the cat. By touching the plantar surface of the foot, especially near the heel, it was possible to elicit regularly a tonic contraction of the gastrocnemius of the same limb. The quadriceps femoris also participated in the response. That exteroceptive stimulation elicited this ipsilateral extension was shown by the fact that brushing the hair on the heel produced this response. It disappeared following section of the tibial nerve at the ankle. The flexors relaxed during the ipsilateral extension and, as in the cat, we have obtained no support for cocontraction of the flexors and the extensors from Stütz positive stimulation in the spinal rabbit.

The responses produced by electrical stimulation were quite variable. In general it may be said that weak stimulation predisposed to crossed extension and stronger stimulation to crossed cocontraction. Frequency reversals were seen in the crossed responses. Very weak faradic stimulation of the tibial nerve at the ankle produced a postural ipsilateral extension. To our knowledge, this is the first time this response has been obtained with electrical stimulation in spinal animals. Stronger stimuli produced either pure ipsilateral flexion or cocontraction.

Rabbits have been found very suitable for the investigation of spinal patterns. They may be kept for long periods following the transection and they require comparatively little care. They are particularly well adapted for the recording of contractions in isolated muscles, because it is possible to do this without the depression of blood pressure that accompanies decerebration. We have recorded reflexes 9½ hours after the original dissection and they were as good at that time as earlier in the experiment.

¹ Hinsey, J. C., and Cutting, C. C., *Am. J. Physiol.*, 1932, **102**, 183.

² Hinsey, J. C., Ranson, S. W., and Doles, E. A., *Am. J. Physiol.*, 1930, **95**, 573.

³ Ranson, S. W., and Hinsey, J. C., *Am. J. Physiol.*, 1930, **94**, 47.