ABNORMAL INNERVATION OF THE CAT SOLEUS MUSCLE

by

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The soleus-nerve muscle preparation has been extensively employed as a standard preparation for physiological and pharmacological studies on mammalian muscle contractile properties (for example Feng & Li, 1941; Brown & Matthews, 1960). This preparation has also been used in the investigation of motor nerve terminal responses (Riker, Roberts, Standaert & Fujimori, 1957; Bowman, Goldberg & Raper, 1969; Riker & Okamoto, 1969), and recently microelectrode analysis of neuromuscular transmission (Hoekman, Dretchen & Standaert, 1974).

The present report is of significance in the surgical preparation of this widely used nerve-muscle system. Further, while evidence of altered physiological or pharmacological responses is lacking, that does not preclude the possibility that the sub-population of cats with this unusual innervation of the soleus muscle may also exhibit aberrant functional responses.

During the past 12 years our laboratories have regularly employed mongrel cats to prepare in situ soleus nerve-muscle preparations (Riker et al., 1957) for pharmacological investigations. Of the more than 2400 animals used for this preparation, 15 (about 0.6%) exhibited abnormal innervation of the soleus muscle; 11 of these observations were made on single-leg preparations in different cats, and 2 were made on double-leg preparations (Okamoto & Riker, 1969; Lowndes, Baker & Riker, 1974) in 2 cats. In these 2 animals the abnormal innervation was present bilaterally.

In normal cats (Crouch, 1969) the soleus nerve arises from the tibial portion of the sciatic nerve. The sciatic nerve arises from the lumbosacral cord, passes dorsocaudally out the pelvic cavity through the great sciatic notch and runs between the muscles of the upper hind limb where it gives off branches to the biceps femoris, semimembranosus and semitendinosus muscles. The
sciatic nerve continues along the abductor canal and where it emerges from
the canal divides into 3 terminal branches: the sural, the common peroneal
and the tibial nerves. Shortly following this division, a branch leads off the
tibial nerve. This branch in turn further separates into 3 bundles as it enters
the lateral gastrocnemius-plantaris muscles with the lateral bundle innervating
the lateral gastrocnemius and the medial bundle innervating the plantaris
muscle. The middle bundle continues along a fascia plane between the lateral
gastrocnemius and the plantaris muscles, emerges from the underside of the
plantaris muscle and then enters the upper side of the soleus muscle in approx-
imately the first 1/4 of the muscle length.

In cats exhibiting the abnormality the soleus nerve is separate and inde-
pendent from the nerves that innervate the lateral gastrocnemius and plantaris
muscles. Rather, the soleus nerve continues along with the tibial portion of
the sciatic nerve. It then leaves the tibial nerve at the level of the underside
of the gastrocnemius-plantaris muscles, turns laterally under the plantaris
muscle, runs for a short course along the surface of the soleus muscle and
innervates that muscle at its usual entrance. Pharmacological and physio-
logical responses tested to date in the abnormally innervated muscles have not
indicated any functional abnormalities.

Another unusual feature that has been observed is a lack of complete separ-
ation of muscle fibres between the plantaris and soleus muscles. This has
been seen in about 120 of the 2400 cats. Small bundles of muscle fibres
(presumably fascicles) leave the soleus muscle cephalad midway along the
muscle length and dorsally enter the plantaris muscle. These muscle fibres
respond to stimulation of the plantaris nerve. In these cats the innervation
of the soleus muscle is normal.

ACKNOWLEDGEMENTS

Helpful discussion and criticism by Dr W. Zeman are gratefully acknow-
ledged. The research was supported by grants UPHS-NINDS-1447 and
NJMS-151400.

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