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"Radial-Paralysis" Syndrome in the Dog

John G. Bowne, D.V.M., Ph.D.

The syndrome of brachial plexus damage is most often depicted as a dropping of the elbow and a knuckling over of the carpus and digits so that the dorsal surface of the digits rests upon the surface of the ground. The above description is often repeated in our veterinary textbooks; however, experimental procedures as well as clinical observations indicate that other manifestations may also be present and observed.

The etiology is usually due to severe trauma to the foreleg so that it is displaced either laterally or caudally, placing undue strain on the nerves of the brachial plexus as they course around the first rib.

Kirk (1951) calls this affliction musculospinal paralysis or "dropped elbow." He attributes the etiology to blows or other injuries in the region of the elbow. Hutyra, Marek and Manninger (1938) recorded a case in a dog in which the cause appeared to be neuritis set up by distemper. They also suggested that axillary adenitis might cause similar symptoms. They further stated that only in rare instances is the paralysis of spinal origin. The author has noted a case of neuritis in a cutaneous branch of the radial nerve following a case of distemper. This particular animal developed chorea and subsequently proceeded to chew off the skin of the dorsal surface of the carpus and forearm.

Two severe clinical cases of foreleg paralysis were euthanized at the owners' insistence and the post mortem findings recorded by the author. The nerves were damaged close to the spinal cord in both cases. In the first instance, the sixth and seventh cervical spinal nerves were avulsed from their attachments in the spinal cord. It was found in the other instance, that the first thoracic and eighth cervical spinal nerves were partially or wholly avulsed from the spinal cord.

The trauma may cause a variety of symptoms from a slight limp to complete loss of the use of the limb. Figure 1 illustrates a clinical case of brachial plexus paralysis in a golden retriever. It was presented to the Stange Memorial Clinic at Iowa State University with a history of severe limping after being struck by a car. This case represents one of the more severe brachial paralysis syndromes. Another case presented to the clinic could not bear weight on the affected limb, but it did not drag the digits as seen in the golden retriever. The latter case held its forearm approximately parallel to the surface of the ground with the shoulder and elbow flexed. This case represents the typical picture seen when only the superior radial nerve trunk was transected in experimental animals.

Fig. 1. A clinical case of brachial plexus paralysis.

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Anatomy

Figure 2 illustrates the schema of the early anastomoses and origin of the nerves of the brachial plexus of the dog. The brachial plexus of the dog is composed of the ventral branches of the fifth, sixth, seventh and eighth cervical and first and second thoracic spinal nerves. Functionally, the sixth, seventh and eighth cervical and first thoracic spinal nerves are the most important. The musculocutaneous, superior radial, axillary, thoraco-dorsal, lateral thoracic-deep pectoral trunk and possibly the median-ulnar nerve trunk are the more important nerves of the brachial plexus from the standpoint of causing symptoms when their function is lost.

The musculocutaneous nerve usually originates from the sixth and seventh cervical spinal nerves; however, it may receive a large branch from the eighth cervical spinal nerve. The axillary receives most of its origin from the seventh and eighth cervical spinal nerve. The superior radial nerve (that portion of the radial nerve trunk that is located just distal to the rami of origin) originates from the seventh and eighth cervical and first thoracic spinal nerves. The median-ulnar nerve trunk was found to be less important in experimental production of the brachial paralysis syndrome. The median-ulnar nerve receives its origin from the eighth cervical and first thoracic spinal nerves. The thoracodorsal nerve originates in part from the axillary and in part from the eighth cervical, before the eighth cervical spinal nerve becomes the superior radial nerve. The lateral thoracic-deep pectoral nerve trunk originates from the eighth cervical and first thoracic spinal nerves. However, it may receive a large branch from the eighth cervical spinal nerve. The axillary receives most of its origin from the seventh and eighth cervical spinal nerve. The superior radial nerve (that portion of the radial nerve trunk that is located just distal to the rami of origin) originates from the seventh and eighth cervical and first thoracic spinal nerves. The median-ulnar nerve trunk was found to be less important in experimental production of the brachial paralysis syndrome. The median-ulnar nerve receives its origin from the eighth cervical and first thoracic spinal nerves. The thoracodorsal nerve originates in part from the axillary and in part from the eighth cervical, before the eighth cervical spinal nerve becomes the superior radial nerve. The lateral thoracic-deep pectoral nerve trunk originates from the eighth cervical and first thoracic spinal nerves.

Fig. 2. Schematic drawing of the brachial plexus of the dog illustrating the origin of the brachial plexus from the ventral branches of the fifth through the eighth cervical and the first two thoracic spinal nerves.


Fig. 3. Superior radial nerve neurectomy. Note that the shoulder and elbow joints are flexed and the forearm is held nearly parallel to the surface of the ground, similar to that seen when the musculocutaneous nerve is faradically stimulated.
nerves shortly after they emerge from the intervertebral foramina.

Functionally, the musculocutaneous nerve controls the motor function of the flexors of the elbow; the axillary nerve controls the flexors of the shoulder joint; the superior radial the extensors of the elbow, (and with the inferior radial nerve trunk) the extensors of the carpus and digits; and the median-ulnar nerve trunk, the flexors of the carpus and digits. The thoracodorsal nerve controls the motor function of the latissimus dorsi which acts to pull the foreleg dorso-caudally, flexing the shoulder joint to some extent. The lateral thoracic-deep pectoral trunk innervates the deep pectoral muscles among others, and stimulation causes the forelimb to be drawn caudally. The above functional description will help to understand the nerves involved when certain symptoms are observed in clinical cases of foreleg paralysis.

Experimental

Figure 3 illustrates an experimental animal in which the superior radial nerve alone has been transected; note that the forearm is held approximately parallel with the surface of the ground. This animal closely approximates a clinical case presented to our clinic. The elbow and shoulder joints are flexed and the carpus and digits are held in the flexed position.

Figure 4 illustrates an experimental animal in which the musculocutaneous and superior radial nerves were resected. Note that the forearm is held approximately perpendicular to the surface of the ground, and that the shoulder is held in the flexed position.

Figure 5 shows the effects of resection of the musculocutaneous, superior radial, median-ulnar and axillary nerves. Note that the shoulder is no longer held in the flexed position and that the elbow drops and the carpus buckles so that the dorsal surface of the digits rest upon the ground. This closely approximates the posture of the clinical case seen in Figure 1.
The sequelae of brachial plexus damage may take a progressively more grave course as time elapses. The loss of innervation of a muscle or group of muscles causes the loss of the trophic influence of the nerve on the muscles as well as a loss of function of the muscle. Therefore, within two weeks post trauma, the denervated muscles start to atrophy and within three months the resultant atrophy is complete.

Loss of nerves high in the brachial plexus causes a loss of cutaneous as well as deep sensations distally. The dog, therefore, may inadvertently damage its lower extremity without knowing it and the resultant wound heals very slowly without the influence of the nervous elements. It may ulcerate in spite of persistent treatment and the animal may suddenly perform self-amputation on the affected portion of the limb.

Not all accident cases cause complete severance of the nerves and a waiting period of two or three weeks may be desirable before exploration or remedial surgery should be attempted. Allam (1951), French, Strain and Jones (1948), French and Starin (1947) have published methods of diagnosing the extent of neural damage in the peripheral nerves.

This report is a summary of a more complete account to be published at a later date of experimental neurectomies performed on the brachial plexus of the dog.

REFERENCES


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