

A special advertising section

Using regenerative medicine to repair spinal cord injury

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For The Education Center

A spinal cord injury can be severely debilitating to both humans and animals. Many conditions of the spinal cord can result in permanent paralysis, and no cures currently are available.

Severe trauma, disk herniation and ischaemia, among other insults, can result in irreversible loss of spinal cord parenchyma for which minimal treatment options exist. A successful treatment protocol for this degree of spinal cord injury would restore neuronal function and effectively replace spinal cord parenchymal architecture.

A significant limiting factor in recovery from severe spinal cord injury is the fact that the mammalian spinal cord has limited potential for spontaneous regeneration. Complete regeneration would require production of new neurons and glia with re-innervation of the damaged spinal cord segment in order to restore normal function.

Bone marrow-derived stem cells can regenerate and heal injured tissue, supply growth factors, enhance tissue architecture, decrease inflammation, activate resident stem cells and contribute to healing. In experimental studies, transplantation groups showed improvement over control groups. Most clinical research studies report beneficial effects of stem cell transplantation. However, the mechanisms of action and underlying behavior of stem cells in the injured spinal cord remain unclear.

Spinal cord injury in dogs is very common and can lead to severe and permanent conditions similar to those seen in humans. The most common forms of injury in dogs arise from acute disk herniation, spinal trauma, fibrocartilagenous embolic myelopathy and chronic diseases such as degenerative myelopathy and spinal stenosis. Regardless of the type of insult resulting in spinal cord injury, initial primary damage comes from the mechanical trauma and then subsequent secondary events, such as impaired blood flow and impairment of the blood-brain barrier.

At Las Vegas Veterinary Specialty Center (LVVSC), we are incorporating stem cell treatments among other regenerative medicine techniques to treat a variety of orthopedic and neurological injuries and diseases. The patient below is used in this report to highlight the potential of regenerative medicine after severe and chronic spinal cord injury.

Patient

Duncan is a 5-year-old neutered male Labrador retriever that presented to LVVSC 18 months before these described treatments as an emergency appointment for acute onset hind-limb paralysis. He was reported to have been in the owners' backyard, acutely vocalized and immediately was unable to ambulate. He was presented to his primary veterinarian and referred to LVVSC for further evaluation.

At presentation, he was evaluated and noted to be otherwise healthy. Hematology, biochemistry, urinalysis, thoracic and abdominal radiographs were unremarkable. He was transferred to the surgical service and placed under general anesthesia that day, and a CT scan was performed of the thoracolumbar spine along with lumbar puncture for CSF collection and analysis. The CT was analyzed both at LVVSC and remotely via

a board-certified radiologist. The CT was determined to be unremarkable, and this, combined with a normal CSF sample, led to a diagnosis of fibrocartilagenous embolic myelopathy.

The Problem

Fibrocartilagenous embolic myelopathy (FCE) is an ischemic injury to the spinal cord that causes a disruption of normal function. The exact etiology is unknown, but it is hypothesized that disk material is somehow forced into the spinal cord vasculature. Essentially, this results in a stroke-like event within the spinal cord. Most cases involve large- or giant-breed dogs with a recent history of vigorous exercise. Miniature schnauzers also are known to be predisposed.

It is suspected in these cases that an underlying hyperlipidemia is the common underlying cause. The clinical signs may be unilateral or bilateral and may affect just the pelvic limbs or all four limbs, pending the location of spinal cord injury. The clinical signs usually do not worsen, and these patients typically are not in pain after the first 24 hours. The prognosis is guarded to good based on the degree of spinal cord injury and the ability to offer treatment. The current treatment of choice is based around aggressive supportive care and physical therapy.

Setback

Initial management of the patient was routine for our practice until he was discharged to the owners 10 days after initial diagnosis. At the time of discharge he was showing gradual progression and had recovered to have notable extensor tone and mild hind-limb motor function. His owners were very dedicated and continued to be enrolled in a formal rehabilitation treatment plan over the next 16 months. Unfortunately, Duncan did not continue to have further improvements and was nonambulatory in his hind limbs. He had been fitted for and was successfully using a cart.



Afflicted with hind-limb paralysis, Duncan needed a cart to get around before he was treated with a BMAC/PRP injection.

Next Move

Sixteen months after the original spinal cord injury, it was elected to undertake further interventional treatment with Duncan. He was anesthetized, and an epidural injection of bone marrow-derived stem cells and platelet-rich plasma (Pure PRP) in equal volumes was injected. LVVSC uses the bone marrow concentrate system provided by Companion Regenerative Therapies to obtain and isolate stem cells from the

patient's bone marrow (BMAC). This system can be used to prepare PRP. Studies have shown that PRP combined with stem cells can be advantageous by allowing PRP to aid in stem cell recruitment, activation and scaffolding.

BMAC and PRP were prepared using standard



Duncan was back on his feet after successful treatment using his bone marrow and platelet-rich plasma.

techniques as described by the manufacturer. Five milliliters of BMAC/PRP was injected into the epidural space via lumbar puncture. This volume was chosen based on routine volumes of analgesics used in similarly sized dogs undergoing routine elective orthopedic surgical procedures at LVVSC. The patient recovered uneventfully from this injection and was returned to his dedicated rehabilitation protocols.

The owners described that Duncan was more energetic within 14 days of the injection. He has been followed weekly by our rehabilitation therapists and is making ongoing gradual improvements. Prior to the BMAC/PRP treatment, Duncan was unable to walk without the assistance of a sling or a cart. He now is able to take multiple steps and stand on his own.

Stem cell transplantation for severe spinal cord injury shows immense promise for the future. There are many unknowns for this type of treatment, including the need to understand the most effective cell dose, cell type, optimal delivery and method of transplantation. However, numerous institutions are evaluating the potential effects of stem cell transplantation for severe spinal cord injury, and the future appears to be filled with potential for positive change. ●

Dr. Mason, Dipl. ACVS, Dipl. ECVS, is chief of staff at Las Vegas Veterinary Specialty Center. His work has been published in many peer-reviewed journals. Dr. Mason lectures throughout the world on a variety of surgical topics, including his interest in treating many orthopedic, soft tissue and spinal injuries using stem cells and platelet rich plasma (PRP). A board-certified small animal veterinary surgeon, he specializes in orthopedic, neurologic, oncologic and general soft tissue surgical procedures.

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