Overview

Stroke, caused by a disruption in the flow of blood to the brain, is the third most deadly disease in the United States and the leading cause of serious disability. Someone in the U.S. has a stroke every 40 seconds, and approximately every four minutes, a life is taken due to stroke.\(^1\) When a stroke occurs, brain cells begin to die in a matter of minutes from oxygen deprivation, and over time, damage caused by inflammation and other mechanisms leaves many patients with permanent physical or cognitive disability.

The two most common types of stroke are ischemic and hemorrhagic. Ischemic strokes result from an inadequate supply of blood and oxygen to the brain due to blockage of an artery, such as by a blood clot. Hemorrhagic strokes result from rupture of a blood vessel or an abnormal vascular structure.

Unfortunately, the only non-surgical emergency treatment available for ischemic stroke (thrombolytic drugs), must be administered within three to four hours, and is only expected to help victims recover more fully, not reverse the effects of the stroke.\(^2\) Due to the narrow window of intervention, it is estimated that less than five percent of stroke victims are able to receive emergency treatment. Even with emergency treatments, stroke often leaves survivors with severe disabilities including loss of mobility, pain, numbness, memory loss, difficulty talking and impaired cognitive ability.

Stroke and Regenerative Medicine

The lack of treatment options for stroke represents an enormous gap in medical care given its high incidence and severity. As stated earlier, the treatments for stroke are currently limited to the acute phase three to four hours after a stroke event. Many of the regenerative medicine technologies in development are targeting the post-stroke rehabilitation period for which there are currently no therapies available. Stem cells from a variety of sources are being transplanted directly into the brain, and promote the repair of ischemic tissue damage by fostering neurogenesis, angiogenesis and chemotaxis, as well as anti-inflammatory action.

Athersys, Inc. is making progress on a Phase 2 trial evaluating the safety and efficacy for MultiStem, an allogeneic cell therapy product. This adult cell therapy is administered to stroke victims within 1–2 days after the stroke—broadening the treatment window available for stroke patients.

Celgene will also soon conduct a Phase 2 trial where placenta-derived stem cells are administered after ischemic stroke to assess safety, tolerability and improvement after stroke.
Cytomedix is developing an autologous stem cell product derived from the patient’s own bone marrow. They are currently expanding a Phase 2 trial in which ischemic stroke patients have these cells administered to the brain 13–19 days post stroke event in order to promote the repair of ischemic tissue damage, thus reducing patient disability.

UK-based ReNeuron is using their neural stem cell therapy, ReN001, in hopes of reversing functional deficits seen in stroke disability even when administered several weeks after the stroke event. Pre-clinical models have proven to be promising and a Phase 1 clinical study is currently underway.

Worldwide, there are several preclinical studies utilizing stem cells to enhance stroke recovery. Scientists at University of Pittsburgh Medical Center and Stanford University are working in collaboration with SanBio, a company developing genetically manipulated bone marrow stromal cells to treat a variety of neurological disorders. The cells are genetically modified to overexpress Notch, a gene that is involved in the development of infant brains.

The team at Neuralstem is also making strides in the stroke cell therapy field, having recently been approved to commence a human ischemic stroke trial. They hope to use spinal cord stem cells to treat the motor deficits, namely paralysis in the arms and legs, which occur due to ischemic stroke.

Regenerative medicine therapies currently being developed may be the best hope for the millions of stroke victims across the world faced with a lifetime of disability and impairment.

**Stroke: Economic Impact**

Stroke victims may also lose the ability to care for themselves and require a constant caretaker or hospice care, which can be emotionally and financially draining for families. Physical therapy, extended hospitalization and long term institutional care required for many victims of stroke, represent an enormous economic and social burden.

| $73+ Billion | $140,000 | 800,000 Patients |
| American Heart Association estimate of annual U.S. aggregate costs of stroke.\(^3\) | Mean lifetime cost of ischemic stroke in the U.S. Ischemic strokes represent approximately 87% of all strokes.\(^3\) | American Heart Association estimate of U.S. patients affected by stroke each year.\(^3\) |