Traumatic lesions of the Central Nervous System (CNS) are one of the principal reasons of permanent disability [1]. As yet there are no effective clinical treatment to restore the loss of motor function, despite the intense research conducted during the last few decades [2].

Spinal cord injury (SCI) occurs when there is any damage to the spinal cord that blocks communication between the brain and the rest of the body. SCI is a prominent neuropathology with an estimated annual global incidence of 15-40 cases per million people with a high incidence in young people. It can produce serious sensory, motor and reflex functional deficits [3]. For that reasons people with SCI suffers long-term functional deficit and, thus, there is a high social and economic impact.

The majority of SCI is produced by fracture or dislocation, resulting in the loss of function immediately behind the injury lesson site [4]. However, SCI can also be produced by an accumulation of blood (hematoma), or compression from tumours (bone tumours, primary or metastatic tumours, lymphomas, multiple myeloma) or infection (due to tuberculosis or fungal infection) [5].

Additionally, SCI can be complete or incomplete and have different severities, based on whether any movement and sensation occurs at or below the level of injury [6]. Severe trauma to the cervical spinal cord is called tetraplegia and produces paralysis of most of the body, including the arms and legs. When the injury affect thoracic nerves (upper, middle, or lower back) the trauma is called paraplegia and produce the paralysis of the trunk and lower extremities [7].

SCI results from primary and secondary injury mechanisms. It is possible to differentiate between the pathophysiological events which characterise the primary injury and the subsequent secondary associated damage [8]. Although the precise mechanisms which characterise the primary injury are not completely understood [6], primary injury refers to the immediate physical injury to the spinal cord as a consequence of primary mechanical damage (laceration, contusion, compression, and contraction of the neural tissue). Pathological changes resulting from primary injury include the massive neuronal and glial cell death associated with the necrotic tissue, haemorrhagic and oedema in the injury epicentre.

The secondary injury, occurs immediately after the primary mechanical damage, and is responsible for the expansion of the injury site. The pathologic events which specifically characterise the secondary sequel include alterations in ionic concentrations, loss of regulation of local and systemic blood pressure, reduced spinal cord blood flow, breakdown of the blood-brain barrier, penetration of serum proteins into the spinal cord, inflammatory responses, apoptosis and necrosis, excitotoxicity, neurotransmitter accumulation, production of free radicals/lipid peroxidation, and imbalance of activated metalloproteinases. In fact, in the penumbra zone, the processes of ischemia, hypoxia, excitotoxicity, free radical formation, protease release and inflammation contribute to the expansion of segmental loss of function [6, 8, 9]. The final outcome is a pathophysiological damage that is far larger than the initial
mechanical wound, consisting of a cyst cavity surrounded by a glial scar that inhibits axon growth [10].

The clinical symptoms of SCI basically depend on what part of the spinal cord area is affected and also depend on injury severity. However, generally SCI patients in addition to body paralysis (mostly trunk, legs and lower extremities) have other important medical complications such as numbness, tingling, incontinence, bowel, and sexual dysfunction. Moreover, they may develop chronic pain, autonomic dysfunction, and spasticity. And, patients with tetraplegia have respiratory complications, frequently develop pneumonia, and also heart (arrhythmias) and circulatory (alteration in the blood pressure) problems.

In general, methylprednisolone (MP) is the only current pharmacotherapy approved for SCI in the human clinic. However its efficacy is limited although this glucocorticoid has been shown to provide neuroprotection after injury [11].

From a point of view of basic science, current research is aimed at trying to prevent the secondary injury through inhibiting the many mechanisms identified, for example reducing free radical damage [12] or reducing excitotoxicity damage to neurons [13]. For that reason many varied novel experimental therapeutic strategies have emerged in the last few years. However, the approach based on cell therapy using lineages of stem cells has been considered by many researchers as having the most potential for the treatment of spinal cord injuries [14]. Although the treatments for SCI currently remain limited, many studies in recent years have shown promise for the future from a clinical translational perspective.

References:
