Traumatic spinal cord injuries: neuroprotection and recent outcomes

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Abstract

Traumatic spinal cord injury has major effects on the injured person. In case of acute complete traumatic spinal cord injury methylprednisolone is a standard treatment option and surgery is often necessary, but these are not a cure for a complete spinal cord injury. This paper analyses the treatment outcomes in 37 cases of complete traumatic spinal cord injuries of which some patients received usual treatment and some patients received cerebrolysin, as neuroprotection and a protocol of intravenous fluids to ensure the spinal cord perfusion pressure augmentation, and standard surgical treatment.

Key words: neuroprotection, paraplegia, spinal cord injury.

Introduction

Spinal cord injury can occur at any age, can lead to paraplegia or quadriplegia and many young people are affected. When a spinal trauma occurs there are two types of lesions associated with a spinal cord injury: a complete spinal cord injury and an incomplete spinal cord injury. In complete spinal cord injury the normal human spinal cord is disrupted. Sandrine Thuret et al showed that spinal cord injury can result from contusion, compression, penetration or maceration of the spinal cord. Spinal cord lesion consists of injury of the neurons, blood vessels injury, bleeding in the central grey matter, spinal cord edema and hypoperfusion of the spinal cord and the dura mater injury. After the acute spinal cord injury, damage to nerve cells and fibers and to supporting cells within the spinal cord continues to progress for several days, perhaps even weeks and it is the secondary damage. Spinal cord injury leads to the death of nervous cells and the interruption of the descending and ascending axonal tracts. Spinal cord injury culminates in glial scarring and the scar is often oriented perpendicular to the neuraxis and appears impenetrable. The scar contains secreted molecular inhibitors of axon growth.

The immediate surgical treatment must remove the tissues causing spinal cord compression, must correct a gross misalignment and must stabilize the spine. During the delayed secondary spinal cord injury the early treatment may reduce the extent of disability. The secondary spinal cord injury is the damage that continues in the hours following trauma and consists of reduction in blood flow at the level of injury, excessive release of neurotransmitters (glutamate), inflamatory response, free radicals attack neurons and

neuronal apoptosis. During this delayed secondary spinal cord injury the treatment may reduce the extent of disability, eg. methylprednisolone given within 8 hours of the injury occuring significantly improves recovery in humans (NASCIS trials I, II and III). After a complete spinal cord injury there are two types of lesions: complete disruption of the spinal cord or different types of scars.

The aim of the present study was to assess clinical outcome in a recent serie of patients, to analyse whether there is a difference in outcome with regard to the standard treatment including methylprednisolone versus the same type of surgical treatment and nonsteroidal anti-inflammatory drugs and to compare the results.

Methods

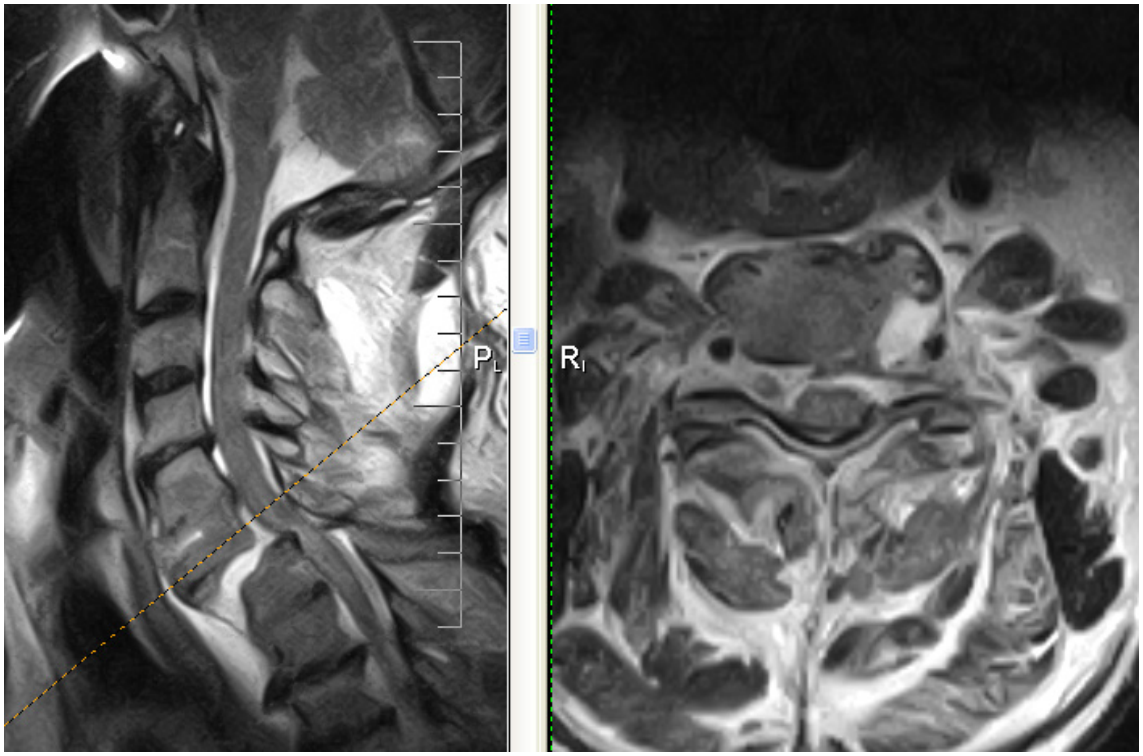
Thirty-seven patients of complete traumatic spinal cord injuries were enrolled in this study.

This study included patients with complete acute traumatic spinal cord injury admitted within 24 hours of injury with a complete neurological evaluations and with CT and /or magnetic resonance imaging before surgery. In a period of 9 months from a total of 262 patients with traumatic spinal cord injuries were 37 patients with complete traumatic spinal cord injuries: A and B score on ASIA scale. There were nine patients with complete cervical injuries with tetraplegia, three patients with dorsal (D5-D7) spinal cord injuries with paraplegia and 25 patients with dorso-lumbar (D11-L1) spinal cord injuries with paraplegia. Thirty-two patients received usual treatment: methylprednisolone and surgery for decompression, to realign and to stabilize the spine and five patients (only A score on ASIA scale) received cerebrolysin and a protocol of intravenous fluids to ensure the spinal cord perfusion pressure augmentation. The five patients group consisted of: two cervical spinal cord injuries, one of medium dorsal spinal cord injury and two patients with dorso-lumbar spinal cord injuries.

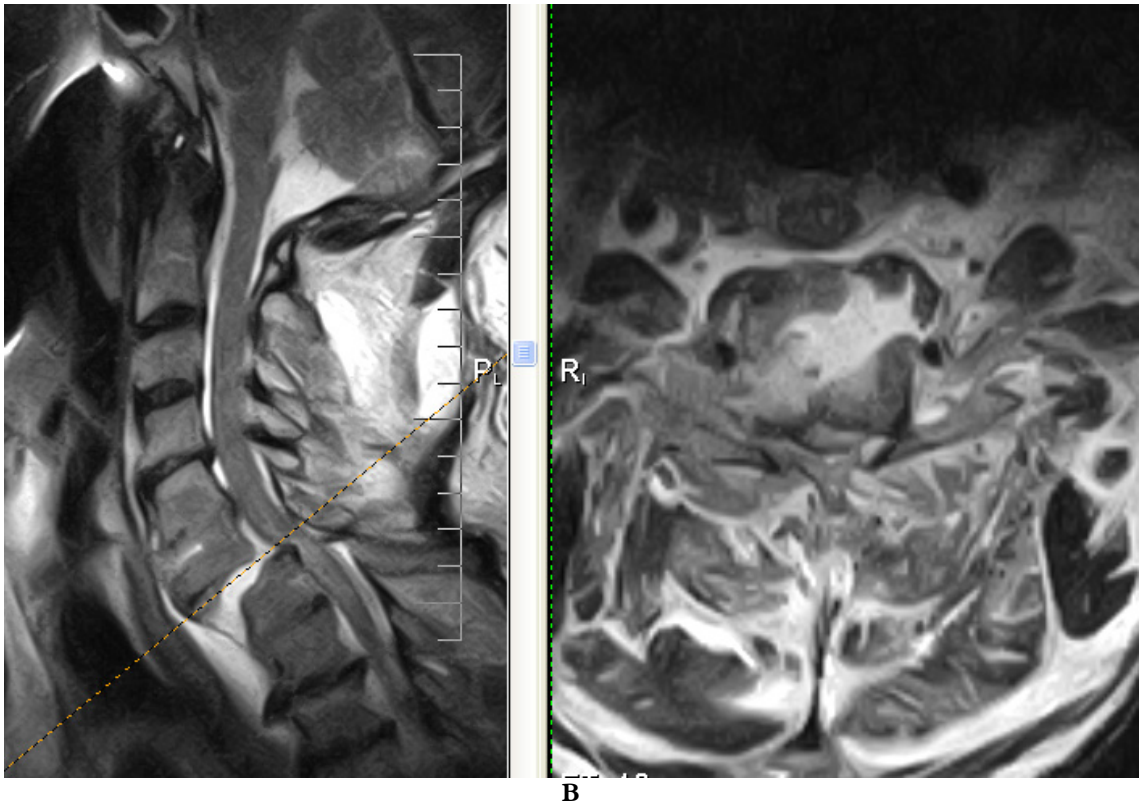
Surgical procedure consisted of spinal cord decompression and then to realign and to stabilize the spine.

Results

Concerning the thirty-two patients with complete chronic spinal cord injury no significant motor or sensory improvements were observed immediate and three to six months afterwards. The five patients group receiving additional therapy presented in evolution a sensory improvements, but no significant motor improvements. Three patients in this group of five patients: one with thoracal and two dorso-lumbar complete spinal cord injuries received cerebrolysin one to three months postoperatively and the results for these three patient were the partial sensory recovery including the sensations of touch, pressure, vibration and pain: from A toB score on ASIA scale.



A



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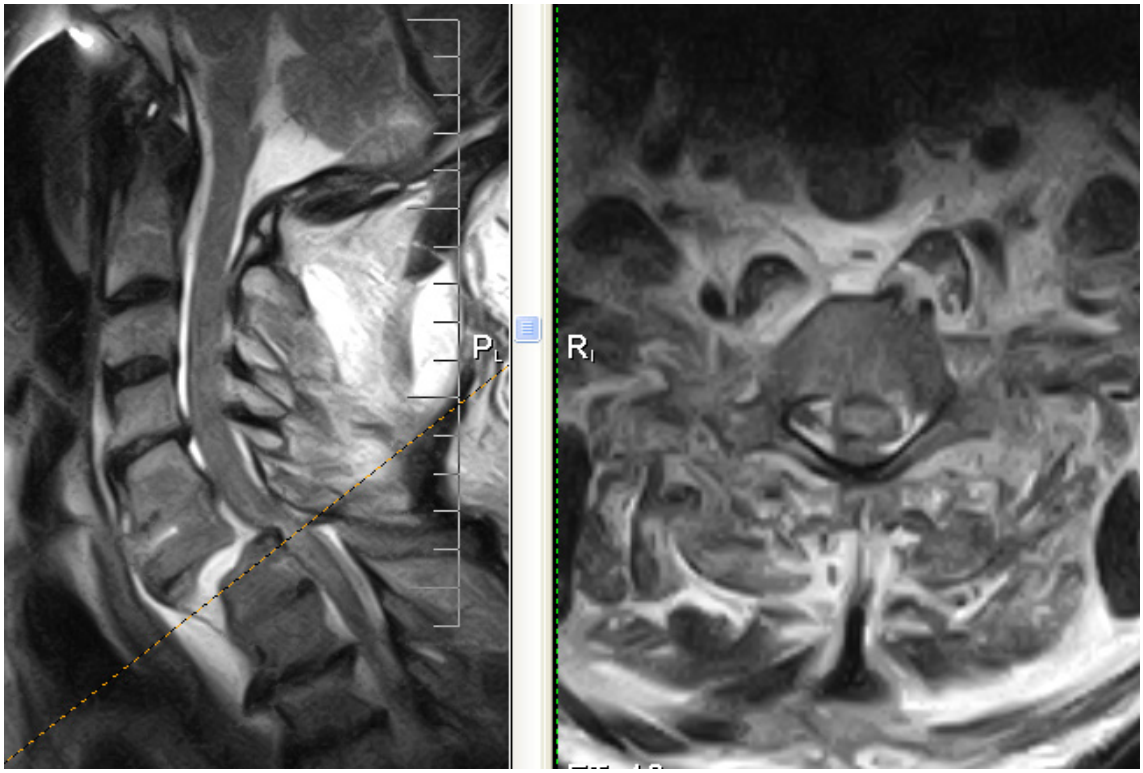

Figure 1 A, B, C
Fracture and dislocation of lower cervical spine (C6-C7) with spinal cord injury (cervical spine MRI)

Discussion

Patients with acute traumatic complete spinal cord injuries with paraplegia or tetraplegia have a complete disruption of the spinal cord, an extensive contusion or an extensive hematoma with secondary spinal cord injury and late maceration of the spinal cord.

Patients with a complete spinal cord injury have an infinitesimal chance of recovery.

The surgical treatment (ideally - within eight hours of the injury occuring) must remove the tissues causing spinal cord compression, must correct a gross misalignment and must stabilize the spine. Therefore immediate surgery for spinal cord decompression including the duraplasty, is of high importance for the prognosis and evolution of spinal cord injury. Various therapies have been applied that may be neuroprotective when administered soon after injury. Some of these therapies are approaches used for other health purposes but have also shown potential in animals with experimental SCI.

Niklas Marklund in an excellent recent material about the spinal cord regeneration said that "the current treatment options for patients with SCI are limited and the neurosurgeon is crucial in the initial management, including the medical stabilization and the timing of the surgical treatment."Also he showed that „initial prehospital management of SCI should follow the ATLS principles including stabilization, airway management and blood pressure control.

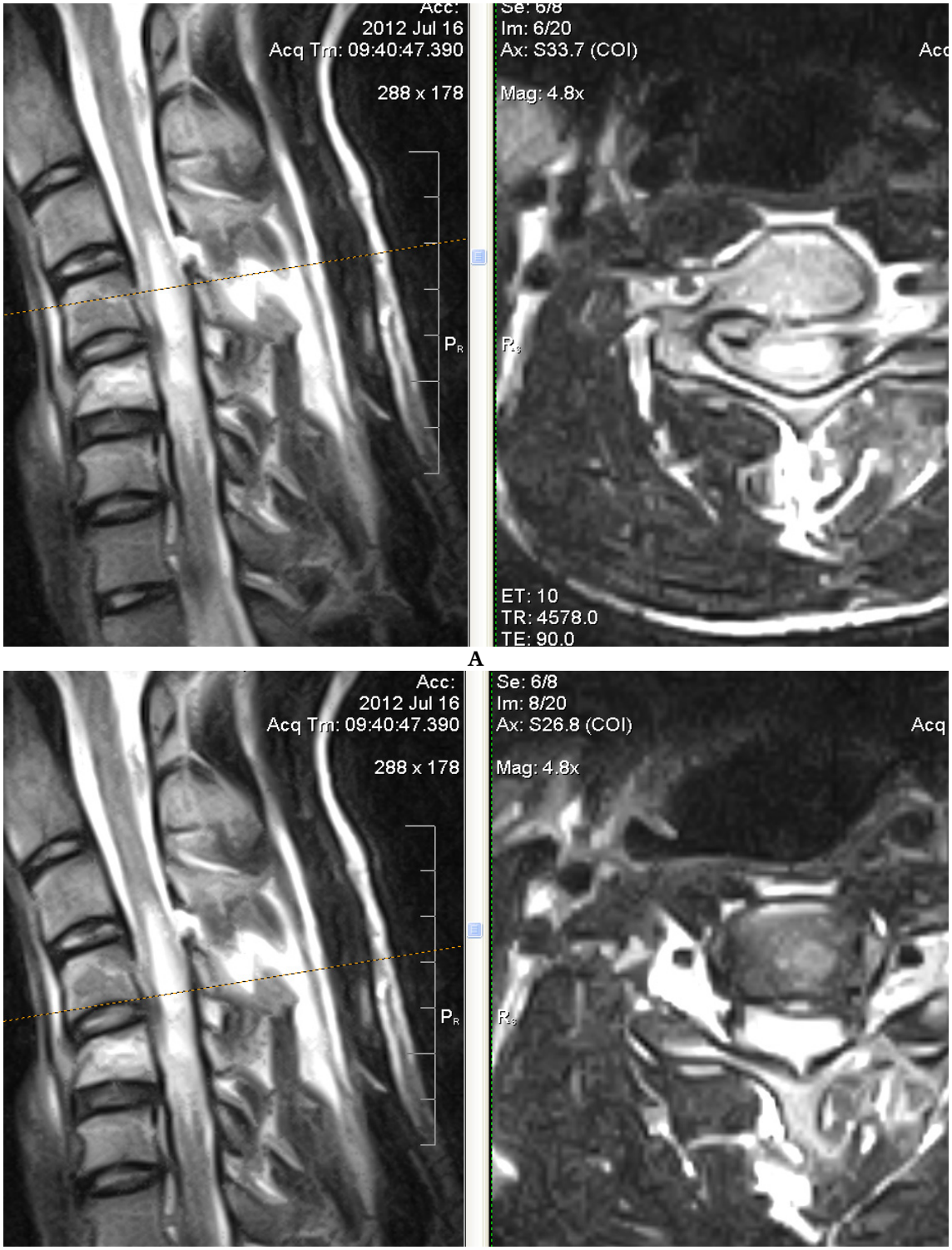

Figure 2 A, B

C5 cervical spina fracture with traumatic acute spinal cord hemorrhage, tetraplegia

Improved patient management and lower morbidity and mortality following acute SCI in specialized centers has repeatedly been demonstrated and it is plausible that the same holds true for intensive care unit monitoring and aggressive medical management of secondary insults." "Methylprednisolone is not standard of care anymore, öptional"at best, although could still be considered in view of the lack of other treatment options".

The current recommendation is to treat all patients with SCI according to the local protocol. If steroids are recommended, they should be initiated within 8 hours of injury with the following steroid protocol: methylprednisolone 30 mg/kg bolus over 15 minutes and an infusion of methylprednisolone at 5.4 mg/kg/h for 23 hours beginning 45 minutes after the bolus.

Other drugs with therapeutic potential in acute spinal cord injury are:

- GM-1 ganglioside (Sygen) decreases injury-induced, over-release of damage-perpetuating excitatory substances.
- Erytropoietin has neuroprotective effects and contributes to neurons regeneration
- neotrofin stimulates growth-factor production, enhances proliferation of CNS stem cells, and protects neurons from the release of excitatory substances.
- minocycline promotes functional recovery, enhances axonal survival, and reduces injury-site lesion size etc.

After passage of acute and subacute stages the patient has a chronic traumatic spinal cord injury with complete paraplegia or complete tetraplegia; he has one of two types of lesions: complete disruption of the spinal cord or different types of scars. The complete disruption of the spinal cord is the interrupting of the continuity of spinal cord without of therapy until now.

The scar of the spinal cord can be:

- a complete and impenetrable glial scar on the site of spinal cord injury,
- an incomplete scar and a post-traumatic syringomyelia or cysts on the site of SCI
- a filiform connective scar of the two segments of damaged spinal cord.

The glial scar is a major impediment to axonal regeneration following injury there is an inability to repair spinal cord damage.

Therefore the first steps in the management of SCI can assure an efficient treatment in order to minimize the direct traumatic effects on the spinal cord and to block the evolution and progression of the secondary spinal cord injury.

In addition of the standard surgical treatment and with or without methylprednisolone, we tryed to give for some patients: cerebrolysin and a protocol of intravenous fluids to ensure the spinal cord perfusion pressure augmentation. The group of thirty-two patients with complete chronic spinal cord injury had no significant motor or sensory improvements immediate and three to six months afterwards. The five patients group receiving additional therapy presented in evolution a sensory improvements, but no significant motor improvements: from A to B score on ASIA scale.

This is a preliminary study of a combination of cerebrolysin and of intravenous fluids to ensure the spinal cord perfusion pressure augmentation in complete traumatic acute spinal cord injury and there are few cases with modest results but promising, compared to the lack of any effective therapeutic alternative.

Conclusion

Initial prehospital management of traumatic acute spinal cord injury is crucial for the

morbidity and mortality following acute SCI. This study show that cerebrolysin as immediate neuroprotective therapy and ensuring the spinal cord perfusion pressure augmentation has no complications and the results are promising, but much follow-up work is needed to document the long-term benefits.

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