



Introduction to the Spinal Trauma: Facts, Conditions and Future Perspective

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According to the current literature, the incidence of spinal trauma with neurological impairment is estimated to be between 18 and 20 cases per million. Usually the most affected patients are young or middle aged, with a male/female ratio of 3,5-4,1 and the trauma is related to road accidents. Spine trauma is also related to work accidents while in the elderly population, the main cause is due to home accidents. Spinal Cord Injuries are between the main reasons of permanent disability, with a high economic and social expense; their incidence is increasing, due to the different lifestyle and the augmented life expectancy. Primary prevention could reduce the global incidence of spinal cord injuries. Secondary prevention, with a correct diagnosis and treatment in the early phase might reduce the number of negative outcomes, and improve the quality of life of the patients with SCI. A careful clinical and radiological assessment, associated with an early surgical treatment, are of main importance to improve the prognosis of the patient. Potential diagnostic improvements can result from radiological innovations: for example the potential use of specific MRI techniques such as Fractional Anisotropy AF and Mean Diffusivity MD as diagnostic or prognostic tools in the field of cervical trauma. The basic idea, however, would be the same as that applied to spinal cord compression caused by spondylarthrosis. Here too, the presence of nerve fibers microstructural damage per se has no direct correlation with the altered signal shown on a T2 MRI, the results of which also have no direct correlation with the presence of accompanying symptoms. It seems clear that FA and MD can have a dramatic impact on prognosis of the SCI. In particular, FA and MD could provide precious information about both the microstructural status of the white fibers in the site directly affected by the trauma, as well as the structures below and above the injury. It is known that secondary bone marrow damage may extend beyond the site of ischemic injury due to axonal degeneration. Emergent surgical treatment is indicated when a spinal cord injury is correlated with clinical symptoms and MRI T2 hyper-intensities. This correlation is used nowadays by a surgeon to identify the site of injury or site of compression that needs decompression. In reality, however, different scenarios can be possible:

There may be a symptomatic patient with negative T2 MRI findings, who would be conservatively treated medically without decompression. The presence of a microstructural damage of the spinal cord as highlighted by FA and MD would provide an indication for emergent surgical decompression.

There may be a patient with an obvious lesion seen in T2. FA and MD can uncover the extent of the damage even at levels above and below the lesion. In this case the extent of the decompression would be better defined, enabling better treatment outcomes for the patient.

There may be a symptomatic patient with no lesion detected on T2: the patient could be treated conservatively and given a good prognosis from the point of view of functional recovery. However, if there is evidence of a microstructural damage on FA and MD, the patient's prognosis would radically change. The impact of these findings on the clinical-therapeutic and medico-legal settings would have significant consequences. In practice, and especially in emergency settings, the use of AF and MD in the evaluation of the spinal trauma is challenging due to the fact that these instruments, as well as the software dedicated to the elaboration of specific sequences, are not widely available. The treatment of patients affected by spinal trauma is influenced both by nonmodifiable variables (fracture morphology and trauma biomechanics, fracture site, neurological status, and associated primary or secondary comorbidities) and modifiable variables (first-aid and transport, hospital, supportive therapy, surgical timing, and other variables directly dependent to the operator). The role of decompressive and reconstructive surgery, and its timing, after acute spinal cord injury in relation to neurological restoration and rehabilitative prognosis is controversial and is still being debated. The clinical outcome of SCI patients might be improved in specialized centers, with intensive care unit and specific trauma management protocols. In the light of this, the multidisciplinary approach to the patient with SCI is key for the treatment of pathology with many social implications. The development of these centers is the instrument with the best guarantee for a continuative and specific treatment that patients with SCI need to obtain the best neurological recovery and improve their quality of life. The continuative assistance in structures where a diagnostic, therapeutic and rehabilitative assistance is available seems to be the best choice for a 360 degrees treatment of patients with SCI and to obtain a reduction in the social and economic impact of this kind of pathologies, with benefits for the patients and for the community.

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