International
Journal of Neurorehabilitation

Research Article Open Access

The Method of Multilevel Decompression of Thoracic Spine with the Durotomy and the Local Administration of Cortexin in the Setting in Intradural Space in the Patients with Spinal Cord Injury

Salkov M*, Tsymbaliuk V and Dzyak L

Dnipropetrovsk State Medical Academy, Neurology and Neurosurgery, Dnipropetrovsk, Ukraine

Abstract

Introduction: We developed the method of the spinal cord decompression and analyzed its efficacy. The essence of the operation lies in the performance of multilevel laminectomy and mandatory durotomy of spinal cord with the local administration of Cortexin.

Purpose: To develop the most efficient tactics of the decompression laminectomy and to study efficacy of the durotomy and local administration of Cortexin in patients with spinal cord injury.

Methods: As of from January 2013 to June 2015 we performed 24 decompression operations in the thoracic spine in the patients with spinal cord injury. In 12 patients the decompression laminectomy was performed without durotomy of spinal cord. In 12 patients the durotomy of spinal cord with the local administration of Cortexin in the setting in intradural space was performed.

Results: The first group of study consisted of 12 patients submitted to the decompression laminectomy without durotomy. Efficacy in the first group of study corresponded to 50 %. In the group 2 we performed the durotomy and local administration of Cortexin in the setting in intradural space (12 patients). The efficacy in the second group corresponded to - 83 %.

Conclusion: The performance of multilevel decompression laminectomy, durotomy and local administration of cortexin is preferable for the full-scale decompression of spinal cord and prevention of the extension of edema. The method makes it possible to improve efficiency of the decompression operations.

Keywords: Spinal injury; Decompression; Laminectomy; Durotomy; Cortexin

Introduction

The rehabilitation treatment of spinal cord injury patients has it's actuality from the very first hours of injury took place. The change in the local autoregulation of blood pressure in the area of the primary damage induces the vascular spasm, results in microcirculation disorder and leads to release of the vasoactive factors such as histamine and nitrogen oxide, which are the major factors of ischemia in the affected area of spinal cord. This involves perfusion pressure decrease and development of vascular dysfunction, ischemia, glutamatergic excitotoxicity, inflammation and apoptosis [1-3].

The concept of decompression and stabilization operation includes a single-step decompression of vertebral canal and stabilization, because corrective measures in the event of vertebral deformity, spinal cord compression and vertebral instability create favourable conditions for implementation of compensation and adaptation mechanisms in the affected spinal cord. For the purpose of rapid decompression of spinal cord, the multilevel laminectomy is considered to be the most successful operation. Wide laminectomy along the entire length of 2-3 vertebra makes it possible not only to perform operative exploration of spinal cord, but to remove anterior compression of contents of the vertebral canal through Urban bone wedge resection or forcible reduction of vertebral dislocation. Full-scale decompression and stabilization even in the setting of the rough spinal injury may cause the improvement in blood supply and cerebrospinal fluid circulation in the vertebral segment and prevention of progression of the pathological process above and below the level of spinal injury [4-7].

The decompressive craniectomy has pretypified the experimental and clinical studies of the spinal canal decompression and durotomy as the method limiting the development of the secondary spinal cord injury. The studies in patients with craniocerebral injury showed high efficacy of the decompressive craniectomy aimed at cerebral decompression by means of removal of part of the bone from the skull and durotomy. During the operation intracranial pressure (ISP) is slowly decreased at the stages of craniotomy and durotomy [8-11].

The most telling example was given by the clinical trials, which proved the positive role of the durotomy in decrease of the intracranial pressure (ICP), limitation of perifocal edema and ischemia in the area of the spinal cord injury [12].

The standard compressive stabilizing operation on the spinal is the laminectomy of liquidation of bone compression and stabilization [13].

We developed the method of the spinal cord decompression and analyzed its efficacy. The essence of the operation lies in the performance of multilevel laminectomy and durotomy with a view to developing reserved space for the affected spinal cord and the local administration of Cortexin in the setting in intradural space.

Cortexin is the medicinal product of Russian origin with neuropeptide structure received through enzymatic hydrolysis of the

***Corresponding author:** Mykola Salkov, Dnipropetrovsk State Medical Academy, Neurology and Neurosurgery, Dnipropetrovsk, Ukraine, Tel: +380505861749; E-mail: salkov@ua.fm

Received June 19, 2015; **Accepted** July 14, 2015; **Published** July 20, 2015

Citation: Salkov M, Tsymbaliuk V, Dzyak L (2015) The Method of Multilevel Decompression of Thoracic Spine with the Durotomy and the Local Administration of Cortexin in the Setting in Intradural Space in the Patients with Spinal Cord Injury. Int J Neurorehabilitation 2: 173. doi:10.4172/2376-0281.1000173

cerebral tissues of pigs and calves. The medicinal product contains the complex of left-handed amino acids and biologically-active polypeptides. The mechanism of action of Cortexin is principally associated with its metabolic activity: it passes freely through the blood-brain barrier and so regulates the balance between inhibitory and excitatory neurotransmitters, serotonin and dopamine levels, has GABA-ergic effect and antioxidative activity, normalizes the Glutamate-Calcium Cascades, slows down the processes of apoptosis. Pharmacological action of Cortexin was studied in the setting of the treatment of craniocerebral injury and its consequences, encephalopathy of different origin, acute and chronic encephalitis and encephalomyelitis, being a part of complex therapy in epilepsy and in different forms of infantile cerebral paralysis in each case the significant clinical effect of the medicinal product was observed [14,15].

Methods

At the Spinal Surgery Department on Mechnikov hospital in Dnepropetrovsk city (Ukraine), stating from January 2013 till June 2015 we have performed 24 decompressions and stabilization operations in the thoracic spine for patients with spinal cord injury. A total of 24 patients (7 (29%) females, 17 (71%) males), aged 18 to 67 with an average age of 32.9 ± 2.2. In 16 cases of falling from the heights and in 10 cases of car accidents. Operations were performed in the first three days from the moment of getting injured. All patients underwent the decompression laminectomy of two laminae (in 9 patients) and of three laminae (in 15 patients). All patients were divided into two groups. The first group consisted of 12 patients (9 (75%) males, 3 (25%) females) submitted to the decompression laminectomy without durotomy of spinal cord. An average age of 33.4 ± 3.3. In 12 patients (8 (67%) males, 4 (33%) females) of the second group the durotomy of spinal cord was performed followed by the local administration of Cortexin in the setting of intradural space and succeeded by the primary Tachocomb grafting. An average age of 32.3 ± 3.0.

The stabilization was performed using nitinol clamps with the shape memory in 16 patients and using transpedicular systems in 8 patients. Trauma of the upper thoracic spine (Th1-Th4) was observed in 7 patients, middle thoracic spine (Th5-Th8) in 8 patients and lower thoracic spine in 9 patients. The severity of neurological impairment according to (American Spinal Injury Association) ASIA scale. In first group ASIA scale "A" in 5 patients, "B" in 4 patients, "C" in 3 patients. In second group ASIA scale "A" in 5 patients, "B" in 5 patients, "C" in 2 patients. Efficacy control was carried out in 30 days after the operation by means of neurological examination using ASIA scale. Comparative observations were not performed among the patients with ASIA scale "D".

We performed comparative analysis of the surgical treatment efficacy in three groups of patients. The first group of study consisted of 12 patients submitted to the decompression laminectomy without durotomy (Group 1). In the second arm of study (12 patients) after the laminectomy we performed the durotomy and administered Cortexin in powdery condition spread on the affected spinal cord and primary duraplasty (Group 2).

In patients who have entered the Group 1, the laminectomy was performed according to the generally accepted standards. We are of the opinion that the most efficacy is achieved with the decompression performed in the upper thoracic spine and middle thoracic spine within 3 laminectomies and in lower thoracic spine within 2 laminectomies. The extension of the laminectomy was due to anatomic difference in size of the spinal bones and spinal cord in the thoracic spine. Final step included the removal of bone fragments, reclination or Urban bone wedge resection and the spinal stabilization procedure.

In the Group 2 we performed the durotomy along the middle line along the entire length of the laminectomy with magnification under the surgical microscope. We performed the operative exploration of spinal cord and restored the cerebrospinal fluid circulation; cerebral detritus was not removed. After we spread Cortexin in powdery condition in a dose of 5 mg on the affected section of spinal cord and dura mater, after which the primary grafting of the dura mater. For the primary grafting of the dura mater we used the Tachocomb plate covering the whole space of the bone resection, after which the Urban bone wedge removing and the spinal stabilization procedure were performed (Figure 1 and 2). In 12 cases we performed the durotomy and primary grafting. In each case after cut of the dura mater we observed the events of hemorrhage and edema in the affected spinal cord that were expressed in the prolapse of the medullary substance beyond the dura mater (Figure 3). Thus, when cut of the dura mater we increased the reserved space for the affected

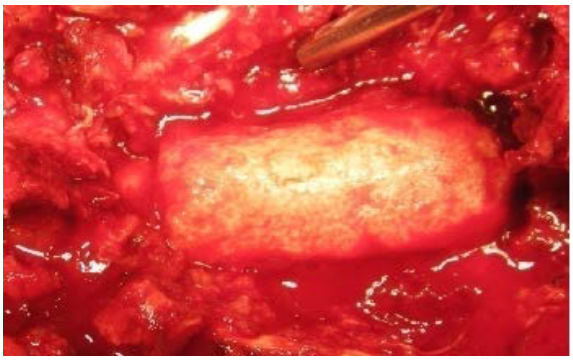

Figure 1: Grafting of the dura mater using the Tachocomb plate.

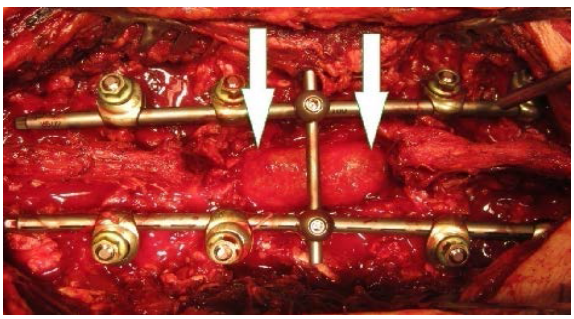

Figure 2: Installed transpedicular stabilization system. The arrows indicate the Tachocomb plate.

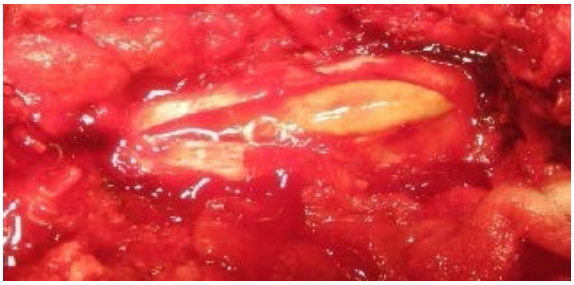

Figure 3: Two laminectomies were performed. Longitudinal section of the dura mater. The edema of spinal cord with the area of hemorrhage.

spinal cord and so improved microcirculation and set bounds to the secondary damage of the medullary substance.

Results

For the assessment of efficacy we used the ASIA scale. In the first arm of study (12 patients) the improvement was observed in 5 patients with ASIA scale "A", 4 patients showed the recovery to ASIA scale "B" and 3 patients to ASIA scale "C".

One patient with ASIA scale "A" showed improvement to ASIA scale "B". Four patients with ASIA scale "A" the dynamics was not observed.

Two patient with ASIA scale "B" showed improvement to ASIA scale "C". Two patients with ASIA scale "B" the dynamics was not observed.

Three patient with ASIA "C" showed improvement to ASIA "D". In 6 patients the neurological dynamics was not observed. Efficacy in the first group of study corresponded to 50 % ($p < 0.05$).

In the second group of study (12 patients) the positive dynamics was observed in 10 patients. Two patients (ASIA scale "A") showed the recovery of deep sensibility and surface sensibility that was corresponding to (ASIA scale "B"). In 1 patient the recovery achieved ASIA scale "C".

The neurological dynamics was not observed in two cases (ASIA scale "A").

In 3 patients with ASIA scale "B" the recovery achieved "C". And two patients with ASIA "B" showed ASIA scale "D". Two patients with ASIA "C" showed improvement to ASIA scale "D". The efficacy in the second group corresponded to 83 % ($p < 0.05$).

Our researches suggest that Cortexin has high tolerability and has no side effects. In making an assessment of the clinical laboratory parameters of changes of the functional status of kidneys and liver, it was found that the lipemic index did not change. Complications in the form of the wound cerebrospinal fluid leak were not observed (Table 1).

Discussion

Experimental studies conducted show high efficacy of the durotomy, as the method limiting the development of the secondary alterations of affected spinal cord in the setting of the spinal cord injury [16-21]. We conducted the experimental studies of the durotomy followed by the local administration of Cortexin on the affected part of spinal cord in rats. When analyzing the changes in neurochemical and functional levels of spinal structure activity in the period of rehabilitation after spinal cord injury, it is possible to observe the optimizing effect of the local administration of Cortexin. In our experiments we used Cortexin, which exhibited essential antioxidant characteristics evident as activation of superoxide dismutase activity and reducing the concentration of products of peroxide lipids oxidation, obviously maintaining sufficient level of the pro-antioxidative balance of nervous tissue, and promoted intensive compensatory cellular metabolism and fast recovery of functional activity of the affected part of spinal cord. Due to antioxidative and neurotrophic effects of Cortexin, its local administration in the setting of traumatic spinal cord injury provides improvement of bioelectric parameters, which make oneself evident in increase in the amplitude of background impulsation of resting electromyogram (EMG) and increase in the frequency of spontaneous oscillations. Effect of the drug is related to the active interaction of Cortexin peptides with neurotransmitter systems, enhancing the functional interaction of neurons and glial cells and improving synaptic transmission and plasticity of the spinal cord tissues. Besides Cortexin is associated with an effects of the insulin-like growth factor (IGF-I), which fulfills a function of autocrine or paracrine agent of proliferation of neurons and glial cells and facilitates their differentiation and survival. It has been established that IGF-I protects the motor neurons against the death of cells in the presence of damage, encourages long neuron renewal, promotes sprouting of nerve terminals and increases the size of neuromuscular contacts. Based on the research findings, we conducted the clinical trial of the durotomy and local administration of Cortexin and proved its high efficacy. We assume that when the dynamics of recovery was not observed, predominant factor was the primary failure of the zone of spinal cord contusion. We developed safe and effective method, which provides an opportunity to reduce the secondary alterations of affected spinal cord and thereby improve the quality of life in patients with the spinal cord injury [14,15].

Changes (ASIA)	1 group	2 group
0	6	2
	50%	17%
1	6	7
	50%	58%
2	0	3
	0%	25%
All Groups	12	12

Table 1: Changes of scale ASIA after surgery (A-A, B-B, C-C, D-D – 0; A-B, B-C, C-D -1; A-C, B-D -2).

Conclusion

The performance of multilevel decompression laminectomy, durotomy and local administration of Cortexin is preferable for the full-scale decompression of spinal cord and prevention of the extension of edema. The method makes it possible to improve efficiency of the decompression operations.

References

1. Ackery A, Robins S, Fehlings MG (2006) Inhibition of Fas – mediated apoptosis through administration of soluble Fas receptor improves functional outcome and reduces posttraumatic axonal degeneration after acute spinal cord injury. J Neurotrauma 23: 604-616.
2. Tator CH (1995) Update on pathophysiology and pathology of acute spinal cord injury. Brain Pathol 5: 407-413.
3. Anderson RL (2009) The role of early surgical decompression of the intradural space following cervical spinal cord injury in an animal model. UCI Undergraduate Research J 12: 1-11.
4. Aganesov AG (2013) The future and the past of surgery for the complicated spine trauma. J Surgery 1: 5-12.
5. Boswell S, Sather M, Kebriaei M, Bowdino B, Tomes D, et al. (2012) Combined open decompressive laminectomy and vertebroplasty for treatment of thoracolumbar fractures retrospective review of 41 cases. Clin Neurol Neurosurg 114: 902-906.
6. Chen T, Long L, Cao G, Cai Y, Liao W (2014) Treatment of thoracolumbar burst fractures by posterior laminotomy decompression and bone grafting via injured vertebrae. Zhongguo Xiu Fu Chong Jian Wai Ke Za Zhi 28: 1236-1240.
7. Yu S, Wu D, Li F, Hou T (2013) Surgical results and prognostic factors for thoracic myelopathy caused by ossification of ligamentum flavum: Posterior surgery by laminectomy. Acta Neurochir (Wien) 155: 1169-1177.
8. Bao YH, Liang YM, Gao GY, Pan YH, Luo QZ (2010) Bilateral decompressive craniectomy for patients with malignant diffuse brain swelling after severe traumatic brain injury: A 37-case study. J Neurotrauma 27: 341-347.
9. Bundgaard H, Landsfeldt U, Cold GE (1998) Subdural monitoring of ICP during craniotomy: Thresholds of cerebral swelling/herniation. Acta Neurochir Suppl 71: 276-278.

10. Burger R, Duncker D, Uzma N, Rohde V (2008) Decompressive craniotomy: Durotomy instead of duroplasty to reduce prolonged ICP elevation. Acta Neurochir Suppl 102: 93-97.

11. Yoo DS, Kim DS, Cho KS, Huh PW, Park CK, et al. (1999) Ventricular pressure monitoring during bilateral decompression with dural expansion. J Neurosurg 91: 953-959.

12. Werndle MC, Saadoun S, Phang I, Czosnyka M, Varsos GV, et al. (2014) Monitoring of spinal cord perfusion pressure in acute spinal cord injury: Initial findings of the injured spinal cord pressure evaluation study. Crit Care Med 42: 646-655.

13. Vaccaro AR, Fehlings MG, Dvorak MF (2010) Spin and spinal cord trauma: Evidence – based management. Thieme, New York.

14. Tsymbaliuk VI, Dzyak LA, Salkov NN, Rodinsky AG, Tkachenko SS (2014) Experimental study of effectiveness of local application of electroneurostimulation, cortexin and methylprednisolone in acute spinal cord injury. J Medical perspectives 19: 51-56.

15. Tsymbaliuk V, Dzyak L, Salkov N, Rodinsky A, Demchenko E (2014) Antioxidant activity of cortexin and eletro stimulation in dynamics of restoration of mobility in rats after spinal cord injury. J Experimental and clinical physiology and biochemistry 4: 5-12.

16. Chavanne A, Pettigrew DB, Holtz JR, Dollin N, Kuntz C (2011) Spinal cord intramedullary pressure in cervical kyphotic deformity: a cadaveric study. Spine (Phila Pa 1976) 36: 1619-1626.

17. Iida H, Tachibana S (1995) Spinal cord intramedullary pressure: Direct cord traction test. Neurol Med Chir (Tokyo) 35: 75-77.

18. Li Y, Walker CL, Zhang YP, Shields CB, Xu XM (2014) Surgical decompression in acute spinal cord injury: A review of clinical evidence, animal model studies, and potential future directions of investigation. Frontiers of Biology J 9: 127-136.

19. Smith J, Anderson R, Pham T, Bhatia N, MD, et al. (2009) The role of decompression with either durotomy or duraplasty following cervical spinal cord injury. Spine J 9: 103-104.

20. Smith J, Anderson R, Pham T, Bhatia N, MD (2010) Role of early surgical decompression of the intradural space after cervical spinal cord injury in an animal model. J Bone Joint Surg Am 92: 1206-1214.

21. Winestone JS, Farley CW, Curt BA, Chavanne A, Dollin N, et al. (2012) Laminectomy, durotomy, and piotomy effects on spinal cord intramedullary pressure in severe cervical and thoracic kyphotic deformity: A cadaveric study. J Neurosurg Spine 16: 195-200.