

Early Decompressive Surgery in Traumatic Thoraco-Lumbar Spine: When and Why?

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Introduction

Spinal trauma is a very common disease, associated with spinal cord injury in 15-30% of cases [1]. The treatment is affected both from non-modifiable variables (fracture's morphology and biomechanics of the trauma, fracture site, neurological status, primary or secondary comorbidities) both from modifiable variables (first aid and hospital transportation, supportive therapy, surgical timing etc.). The role of the surgical timing after acute thoraco-lumbar spinal cord injury is still one of the most controversial points actually debated in literature. Surgical treatment is conditioned both by the general conditions of the patient both by the extent of the neurological deficit. In literature are described three possible windows for surgical timing: early surgery, performed in the first 48 hours; intermediate surgery, performed between 48 hours - 7 days; late surgery, performed after 7 days from the injury. In the light of the debate actually under discussion in literature, the real question is: The implementations of the early surgery have effectively a role in the management of thoraco-lumbar spine injury and, if so, when is mandatory? Actually, based on the literature evidence, is extremely difficult to find a clear indication.

Thoraco-Lumbar Spinal Cord Injury: Current Concept

Spinal cord injury (SCI) is one of the primary causes of neurological damage. Actually there isn't a clear opinion about what is the correct timing of surgical decompression in cases of thoraco-lumbar fractures. Surgery is crucial, in order to reduce secondary damage and to improve patient's outcome [2]. Most of the concerns about the timing of treatment are related to insufficient information about the pathophysiology of the damage and the effects of surgical decompression. In fact spinal cord trauma induces a combination of signs and symptoms associated with earlier and later spinal cord damage [1,3-6]. In particular, traction and compression forces onto the spinal cord, can cause a primary damage to the central gray substance according to high metabolic challenges. These damages are irreversible since the first hours from trauma, while the white matter damage becomes irreversible 72 hours after trauma [1].

Experimental studies show that the length of spinal cord compression causes the severity of the pathological changes and the degree of neurological recovery: the longer is length, the smaller is the possibility of clinical recovery [3,7-9]. Surgical decompression potentially allows a reduction of the intradural pressure, an increase in blood flow to the spinal cord, thus reducing the risk of ischemic lesions and preventing secondary damage [6,10,11]. However it is unclear what should be the better timing for decompressive surgery.

In literature, there are many works concerning the validity and effectiveness of the implementation of an early surgical treatment (within 8 hours of injury). From a literature review we can assure that an early surgery may be associated with an increasing in intra-operative blood loss and the onset of hypotension, with an increased risk of spinal cord ischemic lesions and then neurological deficit. However it guarantees a better outcome, related to an early mobilization of the patient, a shorter hospitalization and a lower risk of pulmonary complications and thromboembolism [6,8,11]. It is important to

underline that a non-modifiable factor that influences surgical timing in the presence of systemic complications, such as major bleeding, shock, sepsis etc.

The presence of these comorbidities causes an unmodifiable delay in surgical treatment, which is unavoidable. Some studies have shown that early surgery (8 hours of injury) has guaranteed a sudden improvement in neurological status and a better outcome in the subsequent follow-up [7,10-15]. Chen et al. [16] have shown that when early surgery is performed, the neurological outcome is closely tied to the neurological pre-operative status. More in detail he shows that there is a greater chance of recovery with a stadium ASIA C and D. In their retrospective study Boakye et al. [17] shows that independent variables such as age, comorbidities and pre-existing AID score, also influenced the outcome.

Surgical time was the strongest predictor of the outcome. In an early surgery there are a lower percentage of postoperative complications (18.7% vs 25.9% for the late surgery) and a reduction in hospitalization (7-10 days vs. 12-15 days). La Rosa et al. [6] conducted a systematic review about this topic, and concluded that a decompressive surgery in less than 24 hours from injury can result in a better neurological outcome. On the contrary, some studies show that in cases of complete or incomplete neurological deficit, the neurological improvement is totally independent of the surgical timing. In a prospective study of 106 patients of Pointillart et al. [18], approximately half of the cohort underwent early surgery (<8 hours) with no improvement in neurological status. McKinley et al. [19] concluded that there weren't differences in neurological status between early surgery (<72 hours from the trauma) and late surgery.

Thoraco-Lumbar Spinal Cord Injury: Our Experience

In the light of the nebulous horizon in literature concerning this crucial topic, we have tried to obtain concrete data about early surgical decompression in thoraco-lumbar spinal cord injury, with the aim to suggest a better definition of optimal surgical timing in this pathological disease. For this reason, we have conducted a descriptive longitudinal retrospective study on 166 patients with thoracolumbar fractures and neurological deficits. All patients enrolled for our study, underwent surgery between 2002 and 2010 at the Neurosurgery Dpt of University Hospital of Rome "Sapienza". All patients were followed up periodically for a period ranging between three years and the eleven years. We analyzed the following variables: age, sex, AO spine classification of the fracture, type of surgical treatment (posterior approach with minimally invasive or open decompression and stabilization when

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TIMING	SITE	AIS SCORE		AO SPINE	SEX		MEDIUM AGE+DS	RECOVERY
		PRE-OP			F=45(27,5%) M=121(72,5%)			
EARLY 1-2 DAYS 42 PTS(25,3%)	D=9 (21,4%)	E=17(60,5%)	A=35(83,3%)	F=12(28,6%)	42.3AA 20,1±DS	MEDIUM HOSPIT.=23 MEDIUM ICU=17 COMPL.=11%		
	L=26(61,9%)	D=7(16,7%)	B=7(16,7%)	M=30(71,4%)				
	D-L=7(16,7%)	C=0	C=0					
		B=9(21,4%)						
		A=9(21,4%)						
INTERMEDIATE 3-7 DAYS 47 PTS(28,3%)	D=11(23,4%)	E=32(68,1%)	A=44(93,6%)	F=8(17%)	44,9 ± 16,1DS	MEDIUM HOSPIT.=29 MEDIUM ICU=18 COMPL.=21%		
	L=24(51,1%)	D=5(10,6%)	B=3(6,4%)	M=39(83%)				
	D-L=12(25%)	C=3(6,4%)	C=0					
		B=4(8,5%)						
		A=3(6,4%)						
LATE >7 DAYS 77 PTS	D=26(33,8%)	E=53(68,8%)	A=70(90,9%)	F=25(32%)	47,6 ±16,9DS	MEDIUM HOSPIT.=37 MEDIUM ICU=26 COMPL.=33%		
	L=34(44,1%)	D=14(18,2%)	B=6(7,8%)	M=52(67,5%)				
	D-L=17(22,1%)	C=4(5,2%)	C=1(1,3%)					
		B=3(3,9%)						
		A=3(3,9%)						

Table 1: First multivariate analysis in which time surgery was correlated with ASIA, skills and patient outcome, expressed as days of hospitalization and comorbidity.

AIS SCALE	SITE	TIMING		
		EARLY 1-2 DAYS	INTERMEDIATE 2-7 DAYS	LATE > 7 DAYS
E=102PTS	D=32(11,4%)	17 PTS	32PTS	53 PTS UNCHANGED
	L=50 (80%)	UNCHANGED =100%	UNCHANGED= 100%	100%
	DL=20(19,6%)			
D=26PTS	D=5(19,2%)	7PT	5PTS	14PTS
	L=15(57,7%)	UNCHANGED=0	UNCHANGED=1(20%)	UNCHANGED=3(21,4%)
	DL=6(23,1)	IMPR.1ASIA=7(100%)	IMPR1 ASIA=4(80%)	IMPR.1ASIA=11(78,6%)
C=7PTS	D=2(28,6%)	0 PTS	3 PTS	4PTS
	L=4(57,1%)		UNCHANGED 1(33,3%)	UNCHANGED=2(50%)
	DL=1(14,3%)		IMPR.1ASIA=1(33,3%)	IMPR.1 ASIA=1(25%)
B=16PTS	D=4(25%)	9PTS	4PT	3 PTS
	L=6(37,5%)	UNCHANGED=1(11,10%)	UNCHANGED=1(25%)	UNCHANGED=2(66,7%),
	DL=6(37,5%)	IMPR.1ASIA=3(33,3%)	IMPR. 1 ASIA=2(50%)	IMPR.1 ASIA=1(33,3%)
A=15PT	D=3(20%)	IMPR 2ASIA=5(55,6%)	IMPR. 2 ASIA=1(25%)	IMPR. 2 ASIA=0
	L=9(60%)	UNCHANGED=100%	UNCHANGED 100%	PTS UNCHANGED =100%
	DL=3(20%)			

Table 2: Second multivariate analysis : the change in the neurological status, expressed through AIS score, was related with the surgical timing.

performed), surgical timing (<48 hours (early), between 48 and 7 days (intermediate) and >7 days (late) and pre and post-operative neurological status , expressed as ASIA-AIS score [20,21]. Cervical trauma wasn't considered in our paper. Osteoporotic and pathological fractures and conservative case were excluded. We conducted three multivariate analyses. These analysis show that, concerning location and type of fracture, early surgical treatment results in a reduction of the median hospital length of stay and ICU stay, as well as in a reduction of cases of nosocomial complications (Table 1). The early surgical treatment appears to provide a better neurological recovery. Better is the ASIA-AIS score on admission, better is the outcome. According to our research, when there are thoracic and lumbar spinal fracture with incomplete neurological deficit, early surgery influences the outcome of patients in terms of better neurological recovery, reduction in hospitalization and reduction of associated comorbidities. The thoracic fractures have the worse outcome. Concerning thoracic location, early treatment seems to have better results: better is the ASIA-AIS score on admission, better is the outcome. Timing doesn't affect the outcome when the ASIA-AIS score is A or E (Table 2). We must implement our research with inclusion of many other variables in relation to the

thoracolumbar trauma, which, however, should not be considered in this multivariate analysis. However, the results seems to be encouraged; in fact, according to the scientific literature, seems to suggest that timing of surgery is the most important factor that could influence the patient outcome, in terms of ASIA-AIS score improvement, when there is a preoperative incomplete neurological damage. In case of complete neurological damage or total absence of damages, timing of surgery doesn't affect the outcome.

Conclusion

Early decompressive surgery in the thoracic and lumbar spine with incomplete neurological damage could positively affect the outcome in terms of neurological recovery, functional restoration, and length of stay and associated comorbidity. Thoracic location of the fracture still has a worst outcome if compared to the other localization, probably because of the vascularization of this segment. Moreover, independently from the localization of the fracture, early surgery seems to have better results when the initial ASIA-AIS score is good; the better the ASIA-AIS score on admission, the better the outcome. Timing doesn't affect the outcome when the ASIA-AIS score is A or E.

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