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Review Article

ROLE OF TIMING IN DECOMPRESSION SURGERY TO IMPROVE NEUROLOGICAL OUTCOME IN ACUTE TRAUMATIC SPINAL CORD INJURY PATIENT

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ABSTRACT

After traumatic cervical spinal cord injuries there is a controversy regarding an optimal timing to perform decompression surgery which can help patient to improve their lost neurological function. Recently so many studies show that early decompression surgery can be beneficial to improve neurological outcome but promising results and reliable sanction is still missing. We analyze and discuss many clinical studies regarding the effectiveness of optimal timing of decompression surgery of traumatic cervical spinal cord injury patient to improve their neurological outcome.

Key words: traumatic cervical spinal cord injury, timing, decompression surgery, neurological recovery

INTRODUCTION

Acute traumatic cervical spinal cord injury is one of the most devastating types of injuries frequently caused by road traffic accidents and most commonly involved the sub-axial spine. Mostly young age is affected by acute traumatic cervical spinal cord injury (ATSCI) and most of them will suffer from severe neurological functional deficits with of course ongoing complex social, psychological and medical needs that decrease their quality of life[1-3]. Around 17,000 new cases per year and more than 250,000 people living in the USA suffers from acute traumatic cervical spinal cord injury making it one of the most significant causes of trauma related morbidity and mortality [4]. Patients suffered from acute cervical spinal cord injury are increasing yearly and many studies over last decades reveals that there is no any recommended medical drug therapy and surgical stabilization and decompression management is only remained option for them, which is published in a guideline in 2013[5-7]. After this guideline is published topic of whether a surgical intervention is ultimate choice or not is closed but still remain a problem of optimal timing of doing this surgical intervention. This dispute is not only regarding to early or late decompression, but also extends to the definitions of early and late surgery as these definitions are also not uniform[8]. We can see this dispute in many studies done previously, some reported that early surgical intervention has better neurological outcomes while other reported that surgery in the early phase further worsened neurological outcomes and survival rates [9-11]. Because dispute is still there for optimal timing and definition of early or late surgery, here we perform a review article of different literatures and put forward available preclinical and clinical evidences (Table 1). At last we will discuss the advantages of doing early decompression surgery to improve neurological outcome of traumatic cervical SCI patients.

Studied by	Design model and size of sample	Definition of time	Effect of Early decompression	Effect of Late decompression
Chie Tanaka et al [12]	retrospective cohort study/236698 patients of which 514 were selected as a study group	●early ≤ 24 hours ●late = 1 to 7 days	● No significant difference in in-hospital mortality. ● No significant difference in the ICU period as well as hospital stay period	
Bourassa-Moreau et al[13]	prospective cohort study/ 53 patients of which 20 are complete SCI	●early <24 hours ●late ≥ 24 hours	● Improve neurological recovery and particularly for those with complete cervical lesions.	● No any significant improvement for those who has done late decompression.

Dvorak, M. F. et al. [14]	A prospective cohort study/ 470 patients.	●early <24 hours ●late ≥ 24 hours	● Significantly increased motor score improvement, additional six motor point improvement for incomplete patients with acute traumatic SCI. ● Reduced acute LOS	● Less favourable neurological improvement and longer LOS.
Fehlings et al [14]	prospective multicenter cohort study/470 patients	● Early < 24 h ● Late > 24 h	● Improved neurologic outcome defined as at least a 2 grade AIS improvement.	● Less favourable neurological outcome.
Ter Wengel et al. [15]	Meta-analysis/ 13 studies and 1126 patients	● Early < 24 h ● Late > 24 h	● Neurological improvement of at least two ASIA grades.	● Less favourable neurological outcome.
Mattiassich, G et al. [16]	Multicentre retrospective analysis/49 patients	● Very early ≤5 h ● Early =5 to 24 h ● Late > 24 h	●Surgical stabilisation between 5 and 24 hours seems to improve the neurological outcomes more than very early decompression.	●less favourable neurological outcome
Liu, Y. et al. [17]	retrospective multicentre study /595 patients	● Early < 72 h ● Late > 72 h	● Early surgical intervention associated with a higher incidence of mortality and neurological deterioration.	● Delayed surgical intervention is relatively safe.

Umerani, M.et al. [18]	Prospective observational study/98 patients	● Early ≤ 24h ● Late > 24 h	● Early intervention shows better neuroprotective effects. ● Better neurological outcome defined as at least 2 grade AIS Improvement.	●less favourable neurological outcome.
Mirza et al [19]	Retrospective/43 patients	● Early < 72 h ● Late > 72 h	●decrease hospitalization time ● decrease complication rate ●improve neurological recovery.	● increase hospitalization time ● increase complication rate ●less favourable neurological recovery.
Guest et al [20]	Retrospective/50 patients	● Early ≤ 24h ● Late > 24 h	●safe and more cost effective ●improved overall motor recovery ●shorter LOS and ICU stay	●longer LOS and ICU stay. ● less favourable neurological outcome

Table 1: Review of different published studies and methods

ICU= intensive care unit, SCI= spinal cord injury, LOS= length of stay, AIS=abbreviated injury scale

RESULTS AND DISCUSSION

Corelating different clinical evidence to determine optimal timing of decompression:

When correlating different clinical evidence, we can find different views on the optimal time to do decompression and different clinical outcomes according to that performed time. Numerous researchers find that early decompression surgery improved neurological outcomes [13-16 18-20], decrease complication time and hospitalization period [18-20]. While some of the researcher state that timing of decompression has nothing to do with neurological outcome[12]. However very few researchers also state that early decompression is associated with higher incidence of mortality and neurological deterioration[17].

Liu. Y et al mention that early surgical intervention was associated with a higher incidence of mortality and neurological deterioration. A total of 595 patients were included of which 212 received early and 383 receive late surgical decompression. Neurological improvement was measured by frankel grading and to those patients who completed at least six months follow-up. At last after 6 months follow-up, 106 patients (61.6 %) in the early group and 204 (64.4 %) in the late group experienced at least a one-grade improvement. He also examined the safety of surgical timing, of the 595 patients, 27 (4.5 %) experienced neurological deterioration: 18 in the early group and nine in the late group. Although high neurological deterioration is seen with early intervention but there is no significant difference in neurological improvement between the early and late groups. Furthermore, he also concluded that, to determine the most appropriate timing of surgery, further studies are necessary[17]

Chie tanaka et al conducted a retrospective cohort study regarding early versus late surgery in cervical spinal cord injury. He selected 514 patients with isolated cervical SCI and underwent surgical decompression within 7 days. He divided patients into two groups, early group who receive surgery within 24 h after injury and late group who has done surgery from 1 day to 7 days after injury. He suggests that timing of surgery doesn't correlate any significant difference in the ICU period and hospital stay period for cervical SCI patients if decompression is performed within 1 week of trauma. But his study didn't contain information about neurological status before and after surgery and he also concluded that further prospective studies are required for confirmation[12].

Bourassa-Moreau et al had also conducted a prospective cohort study with aim to determine the effect of early surgical decompression on neurological recovery in complete SCI patients. 20 cervical cases with complete SCI had taken and 72% of patient has done surgery before 24 hours whereas 28% has done after 24 hours. Neurological recovery was measured by AIS scale. He found that 34% of patient who has done early surgery improved from a complete to an In-complete spine injury, as compared to only 13% of patients who had operated more than 24h after trauma. Finally, he concluded that early surgical intervention within 24h following a traumatic complete SCI may promote neurological recovery[13].

Mattiassich, G. et al has conducted multicentre retrospective analysis of 49 patients with a purpose to determine the median time to do decompression surgery of traumatic SCI patients and to assess the neurological outcomes of patients who has done decompression within 24hours of injury. He also defines less than 5 hours after surgery as a very early group and want to evaluate whether additional neurological improvement will be seen in this group. Neurological improvement is measured by change in AIS grade between preoperative periods to follow up. Total 49 patients were included of which 33 underwent surgery less than 5h and 16 underwent surgery between 5h and 24h. His studies find that in very early group 48% had no AIS improvement, 42% improved by 1 AIS grade, 6% by 2 AIS grades and 3% by 3 AIS grades while in early group, 31% has no AIS improvement while 31% improved by 1 grade and others 31% improved by 2 grade and remaining 6% improved by 3 grades and no patients decreased in AIS grade. Hence early decompression result in significant neurological outcome then very early and late group16.

Ter Wengel, P. V. et al performed a meta-analysis of 13 studies and 1126 patients and neurological outcome was measured in term of improvement of ASIA grade. He defined surgical decompression performed within 24 hours after trauma as early and after 24 hours as late group. In his study he found that the rate of ≥ 2 ASIA grades improvement in the early surgery group was 22.6% compared to the late surgery group of 10.4%. Hence early surgical decompression results in significant improvement of neurological outcome than late surgical decompression[15].

Importance of early surgery in improvement of clinical outcome:

Many researchers state that early decompression to traumatic SCI patient is associated with many advantages like improved neurological outcomes [13-16, 18], decrease hospital stay and decrease complication rates[19, 20]. Since immediately after traumatic cervical SCI small intra-parenchymal haemorrhage starts to develop in grey matter and oedema in white matter which become peak swelling at 48-72 hours after trauma. Since myelin damage after SCI is due to primary and secondary mechanism so doing decompression after 24 hours results in bad neurological recovery and increase many complications[21]. While in case of doing surgery within 12 hours, patients may have concomitants disease and other existing injury which may not be diagnosed that much fast which can later on worsen neurological and clinical outcome postoperatively. Moreover, surgeons working overnight and their fatigue can also deteriorate the patient improvement[21].

CONCLUSION

Many latest clinical studies suggest that optimal timing for decompression to traumatic cervical spinal cord injury is less than 24 hours after trauma which is associated with better neurological recovery, clinical and functional outcomes. Moreover, many studies also concluded that doing surgery after 24 hours of trauma is relatively less advantages to patients to recover their neurological, functional and clinical outcomes, furthermore they also increase duration of hospital stay and complication rates.

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