

Does Early Surgical Decompression in Cauda Equina Syndrome Improve Bladder Outcome?

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Study Design. We analyzed retrospectively whether early surgery for cauda equina syndrome (CES) within 24, 48, or 72 hours of onset of autonomic symptoms made any difference to bladder function at initial outpatient follow-up.

Objective. CES potentially causes loss of autonomic control including bladder dysfunction, resulting in significant disability. There is significant debate regarding appropriate timing of surgery.

Summary of Background Data and Methods. We conducted a retrospective cohort study of 200 patients between 2000 and 2011 who underwent decompressive surgery for CES at a regional neurosurgical center. Data collected were from clinical admission and at initial follow-up. Presentation was categorized into CES with retention (CESR) and incomplete CES (CESI) and duration of autonomic symptoms before surgical intervention.

Results. A total of 200 patients had complete clinical records; 61 cases with CESR and 139 cases with CESI. Average initial follow-up time was 96 days. For the 36 cases with CESI less than 24 hours, normal bladder function was seen at follow-up in all patients except 4 (11.1%), but with 103 cases with CESI more than 24 hours, 48 (46.6%) had bladder dysfunction (Pearson χ^2 $P = 0.000$). For the 64 cases with CESI less than 48 hours, normal bladder function was seen at follow-up in all except 10 (15.6%), but with 75 cases with CESI more than 48 hours, 42 (56%) had bladder dysfunction (Pearson χ^2 $P = 0.000$). For the 35 patients with CESR, operating within 24, 48, or 72 hours made no obvious difference to bladder outcome. Data were also reanalyzed changing the dataset groups to CESI less than 24 hours, 24 to 48 hours, and more than 48 hours to calculate odds ratios regarding normal bladder outcome.

Conclusion. We identified that decompressive surgery within 24 hours of onset of autonomic symptoms in CESI reduces bladder dysfunction at initial follow-up, but no statistically significant difference in outcome was observed in CESR regarding timing of operation.

Key words: cauda equina syndrome, laminectomy, timing of surgery, bladder function, bladder outcome, autonomic function, decompressive surgery, 24 hours, 48 hours, retrospective study.

Level of Evidence: 3

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Cauda equina syndrome (CES) was first described in the English literature by Mixter and Barr in 1934.¹ Compression of the lumbosacral nerve roots beneath the conus medullaris results in sensory-motor symptomatology of the lower limbs and sphincters clinically diagnosed as CES. Symptoms and signs include low back pain, saddle anesthesia, unilateral or bilateral sciatica, and motor weakness of the lower extremities with bladder and bowel dysfunction.^{2,3} The most common cause of CES is herniated lumbar disc, which represents 3% of all Herniated lumbar discs (HLDs) and is an indication for decompressive surgery.^{4,5} The most common levels involved are L4–L5 and L5–S1. Other etiologies include spinal stenosis, spinal tumors, hematomas, fractures, and infections.³ This can lead to loss of autonomic control including bladder dysfunction, resulting in significant disability.

There is considerable debate regarding appropriate timing of surgery.⁶ A meta-analysis by Ahn *et al*,⁷ recommending operating within 48 hours of onset of symptoms, provided a significant improvement in sensory and motor deficits as well as urinary and rectal function for patients. Gleave and McFarlane⁴ stressed the importance of categorizing CES into CES incomplete (CESI) and CES complete with urinary retention (CESR). CESR describes painless urinary retention with overflow incontinence and complete perianal sensory loss. When the patient complains of CESI, the symptoms include urinary issues of neurogenic origin including loss of desire to void, altered urinary sensation, and hesitancy with partial saddle anesthesia. In fact, a meta-analysis by DeLong *et al*⁸ highlighted the importance of categorizing CES into these subtypes and that early surgery did make a clinically significant difference in terms of urinary function even in patients with CESR.

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We analyzed retrospectively whether early surgery for CES within 24, 48, or 72 hours of onset of autonomic symptoms made any difference to bladder function at initial outpatient follow-up.

MATERIALS AND METHODS

We conducted a retrospective cohort study of 200 patient case notes between 2000 and 2011, who underwent emergency decompressive surgery for CES at a single neurosurgical center. Of 343 case notes available, we analyzed 218 patients. Of the 218 patients, 18 were discarded as per the exclusion criteria, mentioned later, leaving 200 case notes left for data analysis. This dataset was acquired from a registry collated by spinal specialist nurses and cross-referenced by the coding department at our institution.

Data collected included patient demographics, pain history, duration of autonomic bladder symptoms prior to surgery, level of herniated lumbar disc, operative details, intra-/postoperative complications, and autonomic outcome at initial follow-up. Presentation was categorized into CESR and CESI and duration of autonomic symptoms before surgical intervention; categorized as less than 24 hours, less than 48 hours, less than 72 hours, and more than 24 hours, more than 48 hours, and more than 72 hours. CESR is defined as painless urinary retention and overflow incontinence \pm complete perianal sensory loss. All CESR cases had a urinary catheter inserted. CESI is defined as altered urinary sensation and partial perianal sensory loss \pm lower back pain \pm unilateral/bilateral sciatica \pm lower limb motor or sensory signs. Chi-square test was applied to each data group to assess for statistical significance using SPSS software (IBM Version 20, 2011). Data were also reanalyzed changing the dataset groups to CESI less than 24 hours, CESI 24 to 48 hours, and CESI more than 48 hours to calculate odds ratios again using the same software.

All cases were patients presenting with CES secondary to a herniated lumbar disc, which was confirmed with magnetic resonance imaging, and presented with some degree of urinary dysfunction, therefore, undergoing surgical decompression within 48 hours of arrival to the neurosurgical unit. All operations were performed by a senior registrar or a consultant in the department. Exclusion criteria were all causes of CES other than herniated lumbar disc such as tumor, discitis, myelitis, or spondylotic stenosis. In addition, patients with incomplete admission notes with regard to timing of autonomic symptoms and incomplete follow-up data were excluded. Revision CES cases were also excluded. Eighteen cases were compatible with the exclusion criteria.

At follow-up, normal bladder function was allocated to patients with complete normal control and function of their bladder. Any patients with postoperative intermittent self-catheterization or even persistent troublesome urinary symptoms were allocated to abnormal bladder function.

RESULTS

Two hundred patients were included; 139 cases with CESI and 61 cases with CESR. Ninety-two patients were male and 108 female. Average age was 40 years. Average follow-up time to

initial appointment was 96 days (median: 79 d; range: 20–388 d). A total of 134 patients had unilateral pain, 47 patients had bilateral sciatica, and 19 had only lower back pain. Most common level of herniated lumbar disc was L5–S1 (Table 1).

For the 36 CESI less than 24 hours, normal bladder function was seen at follow-up in all patients except 4. However, for 103 patients with CESI more than 24 hours, 48 had bladder dysfunction (Pearson χ^2 2-sided $P = 0.000$). In fact, even operating within 48 or 72 hours for patients with CESI made a statistical significant difference (Table 2 and Figure 1). For the 61 patients with CESR, operating within 24, 48, or 72 hours made no statistically significant difference to the autonomic outcome. All patients were operated within 48 hours of admission to the neurosurgical unit.

The datasets for patients with CESI were reorganized to CESI less than 24 hours, CESI 24 to 48 hours, and CESI more than 48 hours. It can be seen from Table 3 that for operating within less than 24 hours for patients with CESI compared with 24 to 48 hours, a patient is 2 times more likely to end up with a normal bladder. This is even more exaggerated when looking at operating within less than 24 hours for CESI compared with more than 48 hours where a patient is 5 times more likely to end up with a normal bladder.

Altogether, there were 11 complications documented in the intra- or postoperative period. This includes 3 dural tears, which were successfully managed either with primary repair or with dural replacement. Five superficial wound infections resolved after a course of targeted antibiotic therapy. One patient had an evacuation of a superficial hematoma secondary to severe worsening back pain postoperatively. One patient developed a severe chest infection, which required management in intensive therapy unit and resolved. One patient had a successful evacuation of postoperative hematoma due to worsening neurology.

DISCUSSION

CES is a rare phenomenon accounting for only 0.12% of lumbar disc herniations.⁵ It is considered an absolute indication for acute surgical intervention.^{7,9} It encompasses a breadth of signs and symptoms due to compression of the lower lumbar nerve roots. There is great variability in the reporting of outcomes after surgical decompression for CES often with small cohort sizes. There is currently no specific outcome measure that fully captures the far-reaching disability of this condition

TABLE 1. Number of Patients and Level of Herniated Lumbar Disc

Level	No. of Patients
L1–L2	1
L2–L3	2
L3–L4	12
L4–L5	80
L5–S1	105

TABLE 2. Bladder Outcome at Initial Follow-up for Incomplete Cauda Equina Syndrome and Complete Cauda Equine Syndrome With Retention Including Timing of Autonomic Signs Before Decompressive Surgery With Associated χ^2P Value

Timing	CESI		P	CESR		P
	Normal Bladder	Abnormal Bladder		Normal Bladder	Abnormal Bladder	
<24 hr	32	4		10	19	
>24 hr	55	48	0	6	26	0.163
<48 hr	54	10		13	32	
>48 hr	33	42	0	3	13	0.5
<72 hr	61	25		13	34	
>72 hr	27	26	0.018	3	11	0.642

CESI indicates incomplete cauda equina syndrome; CESR, complete cauda equina syndrome with retention.

from mechanical back pain, neuropathic pain, motor weakness, and bladder, bowel, and sexual dysfunction. CES is also a topical medicolegal issue because the timing of surgery has been controversial in the literature with differing viewpoints and strong statements.^{3,10,11} Few meta-analyses have been performed during the past 2 decades, which has led to the current guidance of operating within 48 hours.^{7,8} We undertook this study to identify which cohort of patients (CESI or CESR) specifically benefited from early decompressive surgery in CES.

Our results suggest that operating within 24 hours of onset of autonomic symptoms in CESI resulted in resolution of bladder symptoms at follow-up. In contrast, operating within a specified time in patients presenting as CESR did not show a statistically significant trend of resolved urinary symptoms at follow-up. However, there were 16 patients with CESR out of 61 who recovered to normal bladder function after decompressive surgery, with most before 48 hours (Table 2). There was no clinical significance when comparing outcome of bladder dysfunction with age, sex, comorbidities, and intraoperative complications.

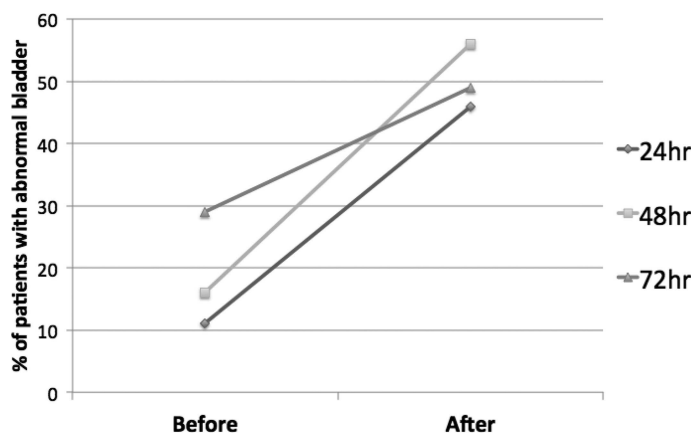


Figure 1. Line graph showing percentage of patients with incomplete cauda equina syndrome who had an abnormal bladder if the operation was before or after a specified time. All 3 times are classified according to color.

Gleave and Mcfarlane¹² analyzed 33 of their CESR cases and concluded that timing of surgery did not correlate with urinary outcome. They felt the “die is cast at the time the prolapse occurs.” A group from San Francisco⁸ performed a meta-analysis of observational studies looking at cases of CESR. They agreed with Gleave and Mcfarlane that it was important to separate CESI and CESR cases and for an experienced surgeon to perform the procedure but thought that there was a “favorable effect” of early surgery on urinary function postoperatively when performed for patients presenting with CESR. Furthermore, a group in India¹³ analyzed 50 patients who presented with a mean delay of 12.2 days for surgery and found that delay in surgery showed a strong positive correlation with longer duration taken for total recovery of sensory, bowel, and bladder dysfunction although this was not statistically significant.

Ahn *et al*⁷ from John Hopkins University, Baltimore, performed a meta-analysis of 322 patients looking at timing of decompression and clinical outcome. Dividing patients into different categories according to time of onset of autonomic symptoms before decompression demonstrated that treating all patients with CES within 48 hours of autonomic symptoms led to significant improvement in sensory, motor deficits

TABLE 3. Bladder Outcome Showing Odds Ratio for Normal Bladder Outcome Depending on Timing of Operation for Patients With Incomplete Cauda Equina Syndrome

CESI Timing	Odds Ratio	95% Confidence Interval
<24 hr vs. 24–48 hr	1.9286	0.4959–7.5002
<24 hr vs. >48 hr	5.04	1.6778–15.1396
24 to 48 hr vs. 48 hr	2.63133	1.0014–6.8201

CESI indicates incomplete cauda equina syndrome.

and urinary and rectal function. Repeat statistical analysis of the same dataset by Kohles *et al*¹⁴ critiqued that a significant improvement in outcome was seen with decompression within 24 hours.

A prospective study analyzed 33 patients undergoing surgery for CES due to HLD, and postoperative outcome was assessed at 3 months and 1 year, with a variety of questionnaires.¹⁵ No statistical significance was found between timing of surgery (<24 hr, 24–48 hr, >48 hr), but a better outcome was found for patients who were continent of urine at presentation than for those who were incontinent. This supports the theory that it is the severity of bladder deficit at presentation that may be a determinant of the outcome. Another study done at the same time¹⁶ reviewed 56 patients presenting with CES. Of the 26 patients who underwent surgery within 48 hours of presentation, 5 were decompressed within 24 hours. It was noticed that postoperative urinary and bowel disturbance was less for patients operated within 24 hours but was not statistically significant.

Our study suggests that operating within 24 hours in patients with CESI improves bladder outcome at the initial follow-up appointment (Tables 2 and 3). This is also statistically significant if operated before 48 and 72 hours. From the odds ratio in Table 3, it can be seen that operating for patients with CESI within 24-hour time period compared with within 24 to 48 hours, there is 1.9 times the chance of achieving normal bladder function at initial follow-up. Operating before 24 hours as opposed to after 48 hours increases chance of normal bladder function at initial follow-up by 5 times.

There are limitations that must be considered in this study. This is a retrospective study; therefore, despite data collection being undertaken in a systematic manner, it is dependent on the history taken by the clerking doctor on arrival to the neurosurgical unit. Furthermore, resolution of bladder symptoms was the outcome measure at initial follow-up. This was obtained from the history taken in clinic; however, no formal bladder function tests or postvoid residual scanning was performed indiscriminately for all patients. Complete follow-up past the initial neurosurgical follow-up for all patients was not achievable because patients with continuing urinary or bowel issues were referred to their local urology or general surgery department for continuing long-term care. Also, the follow-up range is long because some patients were seen early, depending on the consultant's clinic waiting time before initial review and a few patients were seen later as they were recalled after not attending their initial appointments. It is conceivable that with time, some patients may have noticed improvement in their autonomic function, so the data shown here might actually understate the level of improvement seen after decompressive surgery.

CONCLUSION

From our case series of 200 patients categorized into CESI and CESR, we have shown a statistically significant improvement for bladder function if decompressive surgery is performed for

patients with CESI presenting within 24 hours of autonomic disturbance. For patients with CESR, there is no appreciable statistically significant difference. This study supports decompressive surgery for patients with CESI within 24 hours when considering bladder outcome.

➤ Key Points

- ❑ Decompressive surgery for patients with CESI within 24 hours of onset of autonomic symptoms reduces bladder dysfunction at initial follow-up.
- ❑ Decompressive surgery for patients with CESR within 24, 48, or 72 hours does not alter bladder outcome at initial follow-up, which is statistically significant.
- ❑ Patients with CESI are 5 times (odds ratio) more likely to achieve a normal bladder at initial follow-up if operated within 24 hours of onset of autonomic symptoms, as opposed to after 48 hours.

References

1. Mixter WJ, Barr JS. Rupture of the intervertebral disc with involvement of the spinal cord. *N Engl J Med* 1934;211:210–4.
2. Kostuik JP. Controversies in cauda equina syndrome and lumbar disk herniation. *Curr Opin Orthop* 1993;4:125–8.
3. Gardner A, Gardner E, Morley T. Cauda equina syndrome: a review of the current clinical and medico-legal position. *Eur Spine J* 2011;20:690–7.
4. Gleave JRW, Macfarlane R. Cauda equina syndrome: what is the relationship between timing of surgery and outcome? *Br J Neurosurg* 2002;16:325–8.
5. Sorbie C. Cauda equina syndrome. *Orthopaedics* 2009;32:39.
6. Todd NV. Cauda equina syndrome: the timing of surgery probably does influence outcome. *Br J Neurosurg* 2005;19:301–6.
7. Ahn UM, Ahn NU, Buchowski MS, et al. Cauda equina syndrome secondary to lumbar disc herniation. A meta-analysis of surgical outcomes. *Spine* 2000;25:1515–22.
8. DeLong WB, Polissar N, Neradilek B. Timing of surgery in cauda equina syndrome with urinary retention: meta-analysis of observational studies. *J Neurosurg Spine* 2008;8:305–20.
9. Shapiro S. Cauda equina syndrome secondary to disc herniation. *Neurosurgery* 1993;32:743–7.
10. Daniels EW, Gordon Z, French K, et al. Review of medicolegal cases for cauda equina syndrome: what factors lead to an adverse outcome for the provider? *Orthopedics* 2012;35:200.
11. Kostuik JP. Medicolegal consequences of cauda equina syndrome: an overview. *Neurosurg Focus* 2004;16:39–41.
12. Gleave JRW, Macfarlane R. Prognosis for recovery of bladder function following lumbar central disc prolapse. *Br J Neurosurg* 1990;4:205–9.
13. Dhatt S, Tahasildar N, Tripathy SK, et al. Outcome of spinal decompression in cauda equina syndrome presenting late in developing countries: case series of 50 cases. *Eur Spine J* 2011;20:2235–9.
14. Kohles SS, Kohles DA, Karp AP, et al. Time dependent surgical outcomes following cauda equina syndrome diagnosis: comments on a meta-analysis. *Spine* 2004;229:1281–7.
15. Qureshi A, Sell P. Cauda equina syndrome treated by surgical decompression: the influence of timing on surgical outcome. *Eur Spine J* 2007;16:2143–51.
16. McCarthy MJ, Aylott CE, Grevitt MP, et al. Cauda equina syndrome: factors affecting long-term functional and sphincteric outcome. *Spine* 2007;32:207–16.