

## Original Research Article

# Evaluation of relationship between timing of surgery and functional outcome considering the extent of neurological deficit in patients with cauda equina syndrome secondary to lumbar disc herniation

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### ABSTRACT

**Background:** Cauda equina syndrome (CES) is a rare but severe neurological disorder most commonly due to lumbar disc herniation. The role of urgent surgery in improving the outcome of patients with CES remains controversial.

**Methods:** In the present study retrospective evaluation of 44 patients with CES secondary to lumbar disc herniation treated at our hospital between 2009 and 2017 has been done. The patients were categorized into complete (CES-R) and incomplete (CES-I) types of CES and the relationship between timing of surgery and outcome were evaluated.

**Results:** Out of 44 patients, 28 patients presented with CES-I and 16 patients presented with CES-R. In patients with CES-I there was statistically significant difference ( $p=0.0001$ ) in all observed surgical outcome between the patients operated within 48 hrs and those operated after 48 hrs. In patients with CES-R, no correlation was found between onset of symptoms and timing of surgery as recovery was partial in all the patients except 3 who completely recovered, irrespective of their operative times. ( $p=0.494$ ).

**Conclusions:** Early diagnosis and treatment in form of emergency decompressive surgery done within 48 hours of onset of autonomic symptoms in CES-I patients can prevent further neurological damage and deterioration to CES-R. For CES-R patients operating within 48 hours made no difference to their outcome. However, necessary investigations and planned surgery by skilful surgeon should be arranged as soon as is reasonably possible for patients with CES-R.

**Keywords:** Cauda equina syndrome- CES-I & CES-R, Lumbar disc herniation, Surgical outcome

### INTRODUCTION

Cauda equina syndrome (CES) is a severe neurological disorder first described by Mixter and Barr in 1934.<sup>1</sup> It is more common in the developing countries due to late presentation of patients to the hospitals.<sup>2</sup> Several causes of cauda equina syndrome have been reported in the literature, including traumatic injury central disc protrusion prolapse after manipulation and metastatic neoplasm.<sup>3-9</sup> It occurs most frequently following a large central lumbar disc herniation, prolapse or

sequestration.<sup>10</sup> This classical syndrome presents with low back pain with unilateral or bilateral sciatica, saddle anesthesia, lower extremity weakness, bowel and bladder involvement and sexual dysfunction in some cases.<sup>5</sup>

According to literature, two types of CES have been described based on bladder involvement- Complete CES with bladder retention (CES-R) and Incomplete CES (CES-I). When the syndrome is incomplete (CES-Incomplete), the patient has urinary difficulties of neurogenic origin including need to strain in order to

micturate, altered urinary sensation, inability to void and poor urinary stream.<sup>11</sup> Saddle and genital sensory deficit is often unilateral or partial and trigone sensation should be present.

The complete syndrome is characterised by painless urinary retention and overflow incontinence (CES-Retention), when the bladder is no longer under neurogenic control. There is usually extensive or complete saddle and genital sensory deficit and trigone sensation are deficient.

Around 50–70% of patients have urinary retention (CES-R) on initial presentation while 30–50% presents with incomplete syndrome (CES-I). In patients with CES-I, with history less than a few days, emergency MRI should be done to confirm the diagnosis followed by prompt decompression by a suitably experienced surgeon. Every effort should be made to avoid progression of CES-I which is having more favourable prognosis to CES-R while under medical supervision and necessary decisions should be made to prevent its progression. Problems arise in delay in management of patients with CES and there are a variety of opinions regarding the optimum timing for surgery.<sup>5,11-16</sup> Several studies argue that a continuum exist with respect to progressive lengthening in the time to surgery yielding poor outcomes.<sup>17</sup> However, not all studies support this argument which has raised the notion that the principal determinant of outcome may not be timing of surgery but the extent of the neurological deficit prior to surgery.

The aim of our study is to evaluate the relationship between timing of surgery and the functional outcome considering the extent of neurological deficit in patients with cauda equine syndrome secondary to lumbar disc herniation.

## METHODS

We carried out a retrospective review of 44 consecutive patients with cauda equina syndrome secondary to lumbar disc herniation treated at our hospital between 2009 and 2017. We defined cauda equina syndrome as a complex of low back pain, sciatica (pain extending down the lower limb in a dermatomal pattern), saddle hypoaesthesia or anesthesia, and motor weakness in the lower extremities in association with either bowel or bladder dysfunction. Not all criteria were required for the diagnosis to be established. Any patients who did not satisfy these criteria were excluded from the study. Similarly all patients who had CES secondary to trauma or from long-standing neoplasm were excluded. Patients were included to the study on the basis that they had symptoms of urinary dysfunction and saddle hypoaesthesia or anesthesia, with varying degrees of motor and sensory loss in either of the extremities. Basic demographics including symptoms and signs at presentation and the duration of symptoms prior to referral were gathered on all patients. Diagnosis of cauda

equina syndrome was made on the basis of history, physical examination supplemented with imaging. Preoperative Magnetic Resonance Imaging (MRI) was done in all patients to quantify the extent of prolapsed and level of disc herniation. We categorized these patients depending upon the type of bladder involvement at initial presentation as incomplete syndrome (CES-I) and complete syndrome (CES-S). A grading system given by Lee et al based on degree of separation of the cauda equina on T2-weighted axial images was used. Grade 0 = no lumbar stenosis without obliteration of anterior CSF space; grade 1 = mild stenosis with separation of all cauda equina; grade 2 = moderate stenosis with some cauda equina aggregated; and grade 3 = severe stenosis with none of the cauda equina separated.<sup>18</sup> All the patients were operated as early as possible after doing necessary investigation and imaging. All patients underwent wide laminectomy and discectomy. No fixation or fusion was done in any case. The patients were divided into three groups on the basis of time interval between onset of symptoms and surgical intervention as 1) <24 hrs, 2) 24-48 hrs and 3) >48 hrs and the surgical outcomes were evaluated as complete recovery (who had complete recovery of saddle anesthesia, bowel bladder function, sensory and motor power), and partial recovery (who had incomplete recovery with some bladder and bowel dysfunction, partial motor and sensory loss). All data were collected and placed upon a spreadsheet. SPSS version 14 software was utilized for statistical analysis. Chi-square test was utilized for categorical data assessment. Statistical significance was established if  $p < 0.05$ .

## RESULTS

This retrospective study analyzed the follow-up results of 44 patients who underwent wide laminectomy and discectomy following CES secondary to prolapsed intervertebral lumbar discs. Out of these, 26 (59%) patients were male and remaining 18 (41%) were females, whose ages ranged from 23 to 69 years with mean of 52 years. Saddle hypoaesthesia was present in all the patients, back pain was present in 41 (93.18%) patients, motor deficit was present in 38 (86.36%) patients; urinary difficulties in 26 (63.63%) patients and urinary retention in 16 (36.36%) patients. (Table 1) Out of the 44 cases, 34 (77%) had L4-5 prolapsed intervertebral disc (PIVD), 7 (15%) had L5-S1 PIVD, 3 (8%) had multilevel PIVD (most common combination being L4-5, L5-S1) (Figure 1) (Table 2).

Out of 44 patients, 8 (18%) were having grade 2 canal stenosis and remaining 36 (82%) patients were having grade 3 stenosis on MRI (Table 3). The delay in surgery from the onset of the saddle anesthesia and disturbances in micturition (which was arbitrarily considered as a starting point of CES) ranged from 1 to 14 days and mean was 1 day. Out of 44 patients, 23 patients were operated within 24 hours of onset of symptoms, 11 patients within

48 hours and remaining 10 patients after 48 hours of onset of symptoms (Figure 2).

**Table 1: Symptoms and signs in 44 patients with cauda equina syndrome.**

Symptom/sign	Number of patients	Percentage (%)
Back pain	41	93.18
Sciatica – Unilateral	13	29.54
Sciatica – Bilateral	31	70.45
Urinary difficulties	28	63.63
Urinary retention	16	36.36
Saddle hypoesthesia	44	100
Faecal incontinence	16	36.36
Absent anal tone	18	40.91
Absent ankle reflexes	35	79.54
Motor deficit	38	86.36

**Table 2: Level of herniated disc and greatest canal compromise on axial MRI.**

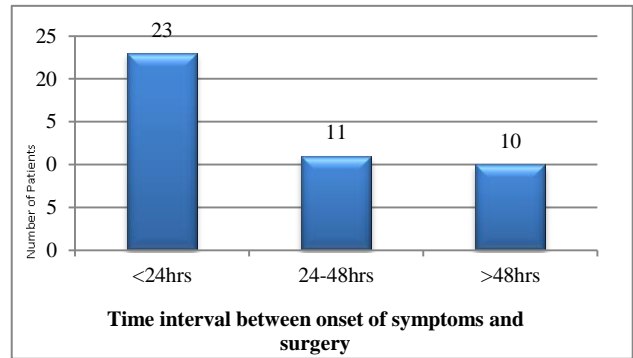
Level of herniated disc	Number of patients (%)
L4/5	34 (77)
L5/S1	7 (15)
Multi-level stenosis	3 (8)



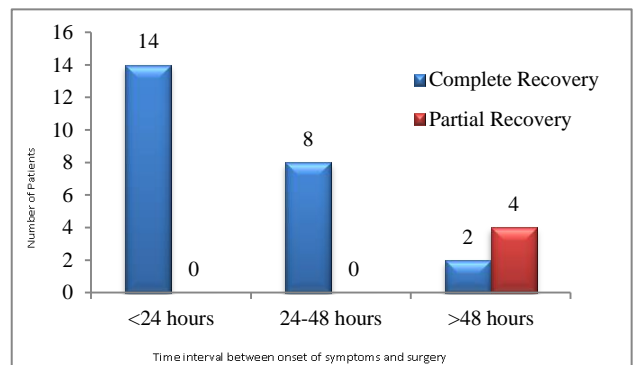
**Figure 1: Pre-operative MRI T2 weighted sagittal section showing a huge L4-5 disc central disc bulge with significant canal compromise in a 58 year old male presenting with cauda equina syndrome.**

Out of 44 patients, 28 (64%) patients had incomplete syndrome (CES-I) and remaining 16 (36%) patients had complete syndrome (CES-S) at initial clinical presentation. Table-Out of 28 patients having incomplete type of CES (CES-I), 14 patients were operated within 24 hours of onset of symptoms and 8 patients were operated between 24-48 hours. All the 22 patients recovered

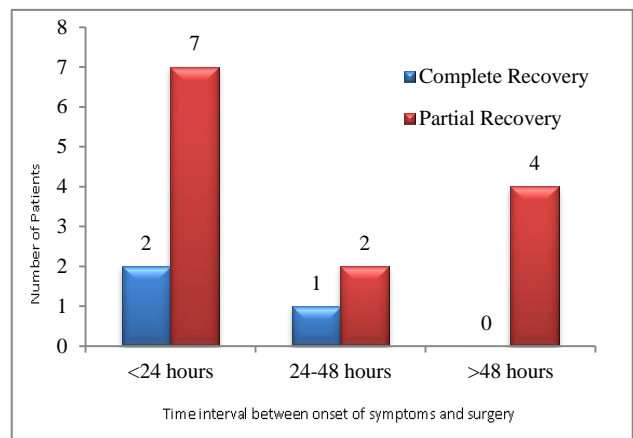
completely with full sensory and motor power along with normal bladder and bowel functions. 6 patients were operated after 48 hours, of which only 2 (33%) patients recovered completely; remaining 4 (67%) patients had partial recovery (Figure 3). There was statistically significant difference ( $p < 0.05$ ) in all observed outcome measures between the patients operated within 48 hrs and those operated after 48 hrs. The duration of recovery for patients with CES-I ranged from 3 to 36 months with a mean of 14 months.



**Figure 2: Number of patients presented with CES in each group.**



**Figure 3: Outcomes of surgery in patients with CES-I in different groups.**



**Figure 4: Outcomes of surgery in patients with CES-R in different groups.**

**Table 3: Grading of lumbar canal stenosis.**

Grade of canal stenosis		Number of patients
<b>Grade 0</b>	No lumbar stenosis without obliteration of anterior CSF space	0
<b>Grade 1</b>	Mild stenosis with separation of all cauda equina	0
<b>Grade 2</b>	Moderate stenosis with some cauda equina aggregated	8 (18%)
<b>Grade 3</b>	Severe stenosis with none of the cauda equina separated	36 (82%)

**Table 4: Cauda equine syndrome comparing outcomes in two different categories with their p value.**

Cauda equina syndrome				
	CES-I (n=28)		CES-R (n=16)	
Time interval between onset of symptoms and surgery	Complete recovery	Partial recovery	Complete recovery	Partial recovery
<b>&lt;24 hours</b>	14	None	2	7
<b>24-48 hours</b>	8	None	1	2
<b>&gt;48 hours</b>	2	4	None	4
<b>p value</b>	0.0001		0.494	

Out of 16 patients having complete type of CES (CES-R), 9 patients were operated within 24 hours of onset of symptoms of which only 2 (22%) patients had complete recovery; remaining 7 (78%) patients had partial recovery. Also 3 patients were operated between 24-48 hours of which 1 (33%) patient recovered completely and other 2 (67%) patients had partial recovery. 4 patients were operated after 48 hours, none of them recovered completely (Figure 4). There was no statistically significant difference ( $p < 0.05$ ) in all observed outcome measures between the patients operated within 48 hrs and those operated after 48 hrs (Table 4). The duration of recovery for patients with CES-R ranged from 12 to 60 months with a mean of 44 months.

The most common pattern of recovery in our group of patients was sensory followed by motor followed by bowel and bladder. Saddle anesthesia persisted in all the patients with partial recovery, which was quite disturbing for the patient. No difference in outcome was seen depending on sex of patient, unilateral/bilateral sciatica or level of disc prolapse. The follow-up period varied from 12 to 60 months, the average follow-up time was 36 months.

## DISCUSSION

CES is a rare entity, accounting for 2–6% of all lumbar disc herniations.<sup>5,6,17</sup> It describes a diverse spectrum of symptoms and signs caused by compression of nerve roots. Early recognition of cauda equina compression caused by lumbar disc prolapse can prevent irreversible sphincter paralysis and neurological damage. In many cases partial loss of control of the sphincter may persist for a long period, but in some cases it can rapidly progress to complete syndrome. The role of urgent surgery in improving the outcome of patients with cauda equina syndrome following lumbar central disc prolapse remains controversial. In our study it was seen that, there

was complete recovery in all the patients with incomplete syndrome who were operated within 48 hrs of onset of symptoms. But delay in treatment after 48 hrs in patients with incomplete syndrome had poorer prognosis due to worsening of neurology to complete syndrome. Also, we observed that surgical outcomes in patients with complete syndrome had no correlation with timing of surgery as recovery was partial in all the patients except 3 who completely recovered, irrespective of their operative times. We observed that major factors that influenced the outcome of the surgery were the severity of the preoperative sphincter disturbance and the extent of saddle anesthesia. So it is advisable that longer the compression continues, the more likely is the long term neurological damage. The prognosis for an individual with established complete CES-R with no bladder sensation or control is probably not time dependent to the same extent as CES-I, but surgery should be carried out by experienced surgeons to avoid the increase in the risk of post-operative complications because any delay in treatment can only worsen neurological recovery. Urgent decompression should be performed at the earliest opportunity but probably not in the middle of the night when circumstances may not be optimal.

We think that it is crucial for doctors who treat patients with lumbar disc disease to realise that early diagnosis and treatment of patients with CES having incomplete syndrome could prevent its conversion to complete syndrome which has poorer prognosis.

Ahn's meta-analysis of 322 cases has shown a significant difference in outcome in those cases decompressed within 48 hrs and those decompressed after 48 hrs.<sup>12</sup> Shapiro in his study noted that delayed surgery group (48 h) demonstrated a significantly greater chance of permanent neurological involvement.<sup>6</sup> Gleave and Macfarlane also concluded that in patients with CES-R there is no evidence to support the view that emergency surgery influences the degree of recovery.<sup>11</sup>



Srikandarajah et al also concluded with similar result, 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.<sup>19</sup> Also, Kostuik et al and O'Laoire et al, concluded that there was no correlation between the length of time between the onset of symptoms and surgery, and the extent of recovery.<sup>5,14</sup>

Also most recent authors have agreed with this finding while others are against the undue delay in surgery as the damaging process is best halted as soon as possible.<sup>20-25</sup>

## CONCLUSION

Early diagnosis and treatment in form of emergency decompressive surgery within 48 hours of onset of autonomic symptoms in CES-I patients can prevent further neurological damage to bladder dysfunction and deterioration to complete syndrome. This encourages prompt referral by early diagnosis and surgical management within 48 hrs of patients presenting with CES-I to reduce the possibility of bladder dysfunction. For CES-R patients operating within 48 hours made no difference to their outcome. The prognosis for an individual with established CES-R with no bladder sensation or control is probably not time dependent to the same extent as CES-I. However, necessary investigations and planned surgery should be arranged as soon as is reasonably possible. Prompt diagnosis followed by timely and skilful surgery and rehabilitation are the essentials in patients with CES-R.

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