



## PROSPECTIVE STUDY OF CAUDA EQUINA SYNDROME WITH PARTICULAR REFERENCE TO BLADDER RECOVERY PATTERN: AN INSTITUTIONAL STUDY

<b>Srikrishna Majhi</b>	MBBS, MCh, Assitant Professor, Department of Neurosurgery, Bangur Institute of Neuroscience, IPGMER, Kolkata, India
<b>Sabyasachi Saha*</b>	MBBS, MS, Post Doctoral Trainee (MCh), Department of Neurosurgery, Bangur Institute of Neuroscience, IPGMER, Kolkata, India *Corresponding author
<b>Anup Kumar Chaudhuri</b>	MBBS, MS, MCh, Professor, Department of Neurosurgery, Bangur Institute of Neuroscience, IPGMER, Kolkata, India

**ABSTRACT** *Objective:* The primary objective of this study was to analyze the bladder recovery patterns in patients admitted with cauda equina syndrome (CES) at the Bangur Institute of Neuroscience, Kolkata, India from May 2018 to Oct 2019.

*Methods:* This was a single center prospective study done at Bangur Institute of Neuroscience, Kolkata, India from May 2018 to Oct 2019. Patients admitted with diagnosis of cauda equina syndrome were included in the study. The following variables were analyzed: gender, age, etiology of the disease, level of the injury, time interval between onset of symptoms and surgery, peri anal sensation (PAS), voluntary anal contraction (VAC), types of surgeries performed, complications, post operative bladder recovery (complete, partial, no recovery).

*Results:* Overall, 32 patients were included in the study. Most of them were males (78%) with an average age of 38.1 years. Most common cause of CES in our study was lumbar disc herniation and L4L5 level was most commonly involved. Only 6 patients (18%) presented before 48 hrs. All of the patients had involvement of bladder function at presentation. On calculation of the association of different factors with bladder recovery pattern we have found that patients undergoing surgery in less than 48 hrs of symptom onset had good bladder recovery than those patients who underwent surgery after 48 hrs and the result is statistically significant (p value 0.008). No bladder recovery was observed in patients with absent anal tone (the result is statistically significant, p value 0.024).

*Conclusion:* So the prospective observational study showed that Cauda equina syndrome is most commonly caused by lumbar prolapsed disc disease. There is significant delay in presentation which is caused by delay in diagnosis and referral. Better outcome in bladder recovery was found in patients who presented to the health facility within 48 hrs and underwent surgery within 48 hrs.

**KEYWORDS :** Cauda equina syndrome (CES), lumbar disc herniation, bladder recovery pattern

### INTRODUCTION:

Cauda equina syndrome (CES) is a neuropathy of two or more nerve roots in the spinal canal below the level of conus medullaris and usually presents with the following typical signs and symptoms: unilateral/bilateral pain radiculopathy, saddle anesthesia or genital sensory disturbance; bladder or bowel incontinence, and lower extremity weakness (1-3)). However, CES is often challenging to diagnose.

CES is rare: incidence rates ranging from 1 in 33,000 to 1 in 100,000 (1) have been reported. In a retrospective study that involved one of the largest cohorts of patients studied to date, it was concluded that the overall incidence of CES was 7 per 100,000 individuals (4). However, the actual occurrence of CES is difficult to estimate partly due to the fact that there is not a single universally accepted clinical definition. The pathogenesis of CES is thought to be mechanical or ischemic compromise of the spinal nerve roots. Spinal nerve root compression commonly occurs in conditions such as acute herniated disc, spinal stenosis, trauma (e.g., burst fractures), metastatic or primary tumors of the spine, or spinal infections (e.g., epidural abscess). CES secondary to lumbosacral intervertebral disc prolapse often presents acutely. Bladder symptoms can either be complete (CES-R) or incomplete (CES-I) (11). CES-R (Cauda Equina Syndrome with urinary retention) are those patients who have complete loss of voluntary bladder control along with either acute retention or overflow incontinence. CES-I (Cauda Equina Syndrome – Incomplete) patients present with vague symptoms such as sensation of incomplete voiding, urgency, poor urinary stream, and urinary straining (11).

The detailed history and the neurological examination is preliminary which is confirmed with imaging studies such as computed tomography (CT) and the gold standard, magnetic resonance imaging (MRI). MRI is solely required for determining the etiology and nature of compression.

CES is a neurosurgical emergency and treatment of which is surgical decompression, which, if performed urgently, reduces neurological damage and improves the outcome.

The primary objective of this study was to analyse the bladder recovery

pattern in patients with Cauda equina syndrome as well as to assess factors influencing bladder recovery.

### MATERIALS AND METHODS:

At first ethical committee clearance was taken from institutional ethical committee. Then this non randomized prospective study was done at the Department of Neurosurgery, Bangur Institute of Neuroscience & SSKM Hospital, Kolkata, India between May 2018 to October 2019. Patients who are fulfilling the criteria of cauda equina syndrome were included in this study. Patients who had one or more of the following findings (a) bladder or bowel dysfunction, (b) reduced sensation in the saddle area, or (c) sexual dysfunction, with possible neurologic deficit in the lower limb (motor/ sensory loss, reflex change) were diagnosed as having cauda equina syndrome and thus included in the study. Those patients who were not willing to participate in this study were excluded.

After written informed consent the following variables were recorded in all patients: age, gender, mode of presentation, clinical symptomatology, clinical findings, intactness of peri anal sensation (PAS), voluntary anal tone (VAC), disease etiology, topographic level of lesion, time delay from onset to surgery, level of neurological deficit, presence of neurogenic bladder, clinical and radiological investigations, type of surgical procedure, post operative evolution and outcome. Perianal sensation (PAS) was recorded as normal/decreased/absent; Voluntary anal contraction (VAC): recorded as normal/weak/absent tone.

Three categories of bladder recovery pattern based on the clinical situation and post-void ultrasonography performed at 3 months and 6 months (follow-up), and the variables were studied. Bladder recovery was defined as 'complete' if the patient did not exhibit any residual bladder symptoms and 'partial' if the patient required to strain but did not require clean intermittent catheterization and had a residual urine volume <100 mL. Those who required intermittent catheterization or had a residual volume >100 mL were considered to have 'no recovery'. Clinical follow-up observations were carried out by outpatient basis at 3 and 6 months after operation.

The data thus generated analyzed statistically using SPSS software, version 26.



Figure 1 MRI Lumbo sacral spine (T2) Axial section showing prolapsed L5S1 disc

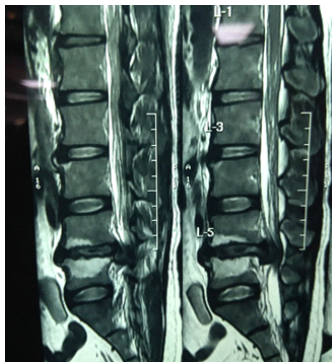


Figure 2 MRI Lumbo Sacral spine Sagittal section showing L5S1 Prolapsed intervertebral disc

**RESULTS:**

36 patients were included initially but 4 patients lost to follow up subsequently, thus a total of 32 patients fulfilled the inclusion criteria and thus included in this study. Among them 25 patients (78.12%) were male and the rest (7 patients) were female (21.88%). The patients had a mean age of 38.84 ± 11 years, ranging from 20 to 65 years. Most of the patients reported to this institution more than 48 h of symptom onset (Table 1). The most prevalent etiologies, in their descending order are shown in Table 2. The most commonly affected topographic levels are L4-5 and L5-S1 (Table 3). Peri Anal Sensation (PAS) was present in 15 patients. 14 patients had decreased PAS whereas 3 patients had absent PAS (Table 4). In our study only 3 patients had intact pre operative anal tone, the rest 29 patients either had weak or absent pre operative anal tone (Table 5). All of the patients in our study had involvement of their bladder function at presentation. 29 patients had urinary retention and 3 patients had to strain during micturition. Majority of the patients (19 patients, 59.4%) in our study experienced no improvement in their bladder function and they are on Clean Intermittent Self Catheterization (CISC). Only 3 patients had complete bladder recovery and the rest 9 patients had partial bladder recovery (Table 6). All patients underwent decompression of the thecal sac. 25 patients were diagnosed to have lumbar prolapsed intervertebral disc. Among them, 14 patients (43%) underwent laminectomy and discectomy and the rest 11 patients underwent fixation along with discectomy. TLIF cage fusion was done in 3 patients. Patients diagnosed to have spinal tumor underwent laminectomy and excision of the tumor. And patients who had CES due to trauma and infection underwent laminectomy with fixation only. Among the total 32 operations we faced complications in 4 patients. Wound infection occurred in 1 patient. Intraoperative dural tear occurred in 2 patients particularly during the dissection of thecal sac off the herniated disc. In both occasions the tear was lateral thus could not be repaired and was managed with muscle patch and fibrin glue. Both the patients didn't develop any post operative CSF leak. One patient developed CSF leak post operatively which was also managed conservatively.

Table 1 Distribution of cases based on time duration between symptom onset and surgery

Time duration between symptom onset and surgery	Patients (n=32)	Percentage (%)
<48 hrs	6	18.7%
>48 hrs	26	81.3%

Table 2 Distribution of cases based on etiology of CES

Etiology	Patients (n=32)	Percentage (%)
Disc herniation	25	78%

Tumor	3	9.4%
Trauma	2	6.3%
Infection	2	6.3%

Table 3 Distribution of cases based on level of lesion

Level of lesion	Patients (n=32)	Percentage (%)
T12	1	3.1%
L1	2	6.2%
L2-3	1	3.1%
L3-4	3	9.4%
L4-5	14	43.8%
L5-S1	11	34.4%

Table 4 Distribution of cases based on Peri anal sensation (PAS)

Peri Anal Sensation	Number of patients (n=32)	Percentage (%)
Absent	3	9.4%
Decreased	14	43.8%
Present	15	46.8%

Table 5 Distribution of cases based on pre operative anal tone

Pre operative anal tone	Number of patients (n=32)	Percentage (%)
Absent	10	31.2%
Weak	19	59.4%
Present	3	9.4%

Table 6 Distribution of cases based on bladder recovery pattern

Bladder recovery pattern	Number of patients(n=32)	Percentage (%)
No recovery	19	59.4%
Partial recovery	9	28.1%
Complete recovery	4	12.5%

Table 7 Association of various factors with the bladder recovery pattern (n=32)

Variable	No recovery	Partial recovery	Complete recovery	Total	p-value
<b>Age group (yr)</b>					0.637
20-40	8	5	3	16	
41-60	9	4	1	14	
>61	2	0	0	2	
<b>Sex</b>					0.984
Male	15	7	3	25	
Female	4	2	1	7	
<b>Etiology</b>					0.129
Lumbar disc herniation	17	4	4	25	
Tumour	1	2	0	3	
Trauma	1	1	0	2	
Infection	0	2	0	2	
<b>Time between onset and surgery</b>					0.008
<48 hrs	2	1	3	6	
>48 hrs	17	8	1	26	
<b>Level of disease</b>					0.983
D12-L1	2	1	0	3	
L2-L3	1	0	0	1	
L3-L4	2	1	0	3	
L4-L5	8	4	2	14	
L5-S1	6	3	2	11	
<b>Peri Anal Sensation</b>					0.320
Absent	3	0	0	3	
Decreased	7	6	1	14	
Present	9	3	3	15	
<b>Anal tone</b>					0.024
Absent	8	2	0	10	
Decreased	11	6	2	19	
Present	0	1	2	3	
<b>Total outcome</b>	19	9	4	32	

On calculation of the association of different factors (as depicted in the above table) with bladder recovery pattern we have found that patients undergoing surgery in less than 48 hrs of symptom onset had good bladder recovery than those patients who underwent surgery after 48 hrs and the result is statistically significant (p value 0.008). No bladder recovery was observed in patients with absent anal tone (the result is statistically significant, p value 0.024). Whereas other variables (age, sex, etiology, level of disease, peri anal sensation) did not affect the bladder recovery pattern (p values 0.673, 0.984, 0.129, 0.983, and 0.320 respectively).

## DISCUSSION

In our study time of 1 year and 6 months we could enlist only 32 cases of CES. CES is often a neglected disease in developing countries. CES cause significant social and financial costs and is still an often-underestimated disease in emergency services. In our present study, more than 81% of the patients ( $n = 26$ ) sought or were referred to our hospital much later than the recommended 48 h. This delay in presentation or referral could be conferred to the overall lack of awareness among the general population as well as physicians of the referring hospitals about the nature of the disease and the role of emergency decompression. In our study we have found that main etiology for CES was lumbar disc herniation (78%), followed by tumor (9.3%) (5, 6) trauma (6%) (7) and infection (6%) (8). **Andre Luiz et al** in their study of epidemiology of CES found similar results (9).

Bladder recovery patterns were categorized using a simple classification system. **A P Reddy et al** in their study of 39 patients of CES found that patients with the presence or reduction of PAS were significantly more likely to show a complete or partial recovery pattern, irrespective of VAC (10) but we could not found such association. We also found that altered VAC had 91% sensitivity for the diagnosis of CES. **Ashok Pedabelle Reddy et al** in their study found the sensitivity of altered VAC was 100% for the diagnosis of CES (10). In their study the purpose of classifying bladder recovery pattern was to know the prognosis, predict the need for self-catheterization, and determine whether the post-void urine volume would be harmful to the upper urinary tract system. They considered the post-void volume as <100 mL based on the general recommendation of the urologist who considered any residue >100 mL as abnormal. They have concluded that perianal sensation (PAS) has significant correlation with neurological recovery and in the absence of PAS bladder function did not recover (10). There is extensive research by several authors to know the association between the surgery duration in CES from the time of symptom onset and outcome, and early surgery is recommended, when feasible (11, 12). Most patients (81%) in our study presented after 48 hours of symptom onset; however rest of the patients who presented and operated within 48 hours had better outcome with respect to bladder recovery. Our findings were similar to those reported by **Beculic et al** (13). **Balasubramanian et al.** (14) noted that the only significant finding associated with CES is saddle anesthesia. It is caused by the compression of the S2, S3, and S4 roots and can be evaluated clinically by checking PAS; it can be graded as normal, absent, or decreased. We noticed that PAS was affected only in 53% of the patients.

It may be debatable as to how PAS was reported as 'normal' in 47% cases of CES where saddle anesthesia was a hallmark; it is difficult to explain this finding. PAS is more of a subjective finding, and the data were recorded as reported by the patient; therefore, there is a chance for bias. The patients who reported PAS as normal may have actually experienced reduced sensation in the perianal region.

A range of 7.6%–52% has been reported in the literature for the association of VAC with CES (15, 16). We found that VAC was either absent or weak in 91% of the patients. This was an objective finding; therefore, it is less likely to be a false positive.

In the current study, bladder function was 'complete,' 'partial,' or 'no recovery' in 12.5%, 18.1%, and 59.4% of the patients, respectively. **Beculic et al.** (13) who reported that 36%, 36%, and 28% of the patients had normal, partial retention, and complete retention of bladder function, respectively, at the final follow-up.

All the patients in our study underwent decompression with or without fusion and tumor excision (in cases of CES caused by tumor). The correlation between bladder recovery and surgery type was not performed because we believe that the primary objective of surgery in CES was adequate decompression, and fusion, based on any obvious or impending instability.

## Limitation

There were few limitations in our study. One important limitation was that we did not assess the CES type in terms of whether it was complete or incomplete. This study was performed within a time frame of 1 year and 6 months which is a short period for complete assessment of the rare disease like CES.

## CONCLUSION

So the prospective observational study showed that Cauda equina

syndrome is most commonly caused by lumbar prolapsed disc disease. There is significant delay in presentation which is caused by delay in diagnosis and referral. Better outcome in bladder recovery was found in patients who presented to the health facility within 48 hrs and underwent surgery within 48 hrs.

## Conflict of interest

There is no potential conflict of interest in this study.

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