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ORIGINAL RESEARCH

To study the factors that influence the recovery of patients with prolapsed lumbar intervertebral disc and cauda equina syndrome

[1]Dr. Gograj Garhwal, [2]Dr. Dilip Nagarwal, [3]Dr. Sushil Acharya, [4]Dr. Kamlakant Khatri, [5]Dr. Piyush Kumar Modi

[1]Assistant Professor, [3]Professor, [4,5]Senior Resident, Department of Neurosurgery, Jawahar Lal Nehru Medical College and Hospital, Ajmer, Rajasthan, India
[2]Assistant Professor, Department of Neurology Jawahar Lal Nehru Medical College and Hospital, Ajmer, Rajasthan, India

Corresponding author
Dr. Sushil Acharya
Professor, Department of Neurosurgery, Jawahar Lal Nehru Medical College and Hospital, Ajmer, Rajasthan, India

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ABSTRACT

Aim: To study the factors that influence the recovery of patients with prolapsed lumbar intervertebral disc and cauda equina syndrome. **Materials and Methods:** This prospective study was conducted in the Department of Neurosurgery, focusing on 50 cases of cauda equina syndrome (CES) due to lumbar intervertebral disc herniation. Inclusion criteria were broad, encompassing patients of all age groups and sexes who presented with symptoms and signs of cauda equina syndrome due to a prolapsed lumbar intervertebral disc. Recurrent cases of cauda equina syndrome due to prolapsed lumbar intervertebral disc were also included in the study. Overall surgical outcome was evaluated as good (complete recovery of bowel and bladder function, saddle anesthesia, sciatica, sensory and motor power), fair (complete recovery of sciatica, saddle anesthesia, and defecation dysfunction, with some difficulty during micturition but no need for intermittent catheterization), and poor (low back pain and sciatica recovered in most patients, some recovery of saddle anesthesia and bowel and bladder dysfunction, and required intermittent catheterization). **Results:** Patients were categorized into complete CES (CES-R) and incomplete CES (CES-I) based on the severity of their symptoms. Twenty patients (40%) were classified as having complete CES, characterized by more severe neurological deficits such as painless urinary retention or fecal incontinence. The remaining 30 patients (60%) were classified as having incomplete CES, with less severe symptoms such as altered urinary sensation and decreased perianal sensory loss.Bladder outcomes were assessed six months post-surgery. Twenty patients (40%) had an excellent outcome, with normal bladder function and no residual symptoms. Fifteen patients (30%) showed a good outcome, with definite improvement and residual urine volume less than 100ml without the need for intermittent catheterization. The remaining 15 patients (30%) had a poor outcome, requiring intermittent catheterization with residual urine volume greater than 100ml. These results highlight the variability in bladder recovery among CES patients.The overall surgical outcomes were evaluated at six months post-surgery. Twenty-five patients (50%) had a good outcome, with complete recovery of bowel and bladder function, saddle anesthesia, sciatica, and sensory and motor power. Fifteen patients (30%) had a fair outcome, with recovery of sciatica, saddle anesthesia, and defecation dysfunction, but some difficulty during micturition without the need for intermittent catheterization. Ten patients (20%) had a poor outcome, with some recovery of saddle anesthesia and bowel and bladder dysfunction but required intermittent catheterization. These outcomes underscore the importance of timely and appropriate surgical intervention in improving the prognosis of CES patients. **Conclusion:** The study highlights the critical role of timely and appropriate surgical intervention in the management of cauda equina syndrome. The variability in symptom onset, severity, and recovery outcomes underscores the need for individualized treatment plans.

Keywords: Prolapsed lumbar intervertebral disc, cauda equina syndrome

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INTRODUCTION

Cauda equina syndrome (CES) represents a significant and urgent clinical condition resulting from compression of the cauda equina, a bundle of spinal nerves and nerve roots at the lower end of the spinal cord. This syndrome can lead to severe neurological impairment, including motor and sensory deficits, bladder and bowel dysfunction, and sexual dysfunction. The most common cause of CES is a prolapsed lumbar intervertebral disc, which accounts for the majority of cases. Other etiologies include spinal stenosis, tumors, infections, trauma, and surgical complications. The management and prognosis of CES are highly dependent on the timely diagnosis and intervention, with the primary goal being to relieve the pressure on the cauda equina nerves to prevent irreversible damage.[1,2]Understanding the factors affecting the recovery of CES in patients with prolapsed lumbar intervertebral disc is crucial for improving patient outcomes. Various factors, including the timing of surgical intervention, the severity of initial symptoms, pre-existing health conditions, and the type of surgical procedure performed, play a significant role in determining the recovery trajectory.[3]One of the most critical factors influencing recovery is the timing of surgical decompression. Early surgical intervention, ideally within 24 to 48 hours of symptom onset, has been shown to significantly improve neurological outcomes. Delays in surgery can lead to permanent nerve damage, resulting in persistent deficits such as bladder and bowel dysfunction, sexual dysfunction, and lower extremity weakness. Studies have consistently demonstrated that patients who undergo early decompression are more likely to regain normal bladder function and have better overall recovery compared to those who experience delayed intervention. The window for optimal surgical timing underscores the importance of prompt diagnosis and referral for surgical management.[4]

The severity of initial symptoms at presentation is another pivotal factor affecting recovery. Patients with complete CES, characterized by painless urinary retention or overflow incontinence and severe motor and sensory deficits, typically have a poorer prognosis compared to those with incomplete CES. Incomplete CES, where patients retain some degree of motor and sensory function and have milder urinary symptoms, is associated with a higher likelihood of recovery. The extent of neurological impairment at the time of diagnosis is directly related to the degree of nerve damage, which in turn influences the potential for neurological recovery following decompression surgery.[5]Pre-existing health conditions and overall patient health also significantly impact recovery outcomes. Conditions such as diabetes, cardiovascular disease, and other chronic illnesses can complicate the postoperative course and hinder recovery. For instance, diabetes can impair wound healing and increase the risk of infections, while cardiovascular diseases may limit the patient's ability to participate in rehabilitation programs. Additionally, the patient's age and general physical condition can influence recovery, with younger, healthier individuals generally experiencing better outcomes.[6,7]The type of surgical procedure performed to decompress the cauda equina nerves can also affect recovery. Common surgical approaches include standard wide laminectomy with discectomy and microdiscectomy. While both procedures aim to relieve nerve compression, the choice of technique may depend on the specific characteristics of the disc herniation and the surgeon's expertise. Microdiscectomy, which involves smaller incisions and less tissue disruption, may offer advantages in terms of reduced operative time, less postoperative pain, and quicker recovery compared to standard laminectomy. However, the overall effectiveness of the procedure in decompressing the nerves and relieving symptoms remains the primary determinant of recovery.[8]Postoperative care and rehabilitation are essential components of the recovery process. Early mobilization, physical therapy, and exercises to strengthen the back and lower extremities can significantly enhance recovery. Patients are typically encouraged to walk on the second postoperative day and engage in isometric abdominal and lower extremity exercises. The use of a lumbosacral belt and avoidance of activities that strain the spine, such as forward bending, prolonged sitting, and lifting heavy weights, are recommended to support healing and prevent recurrence. Regular follow-up and monitoring of bladder function, motor and sensory recovery, and overall well-being are crucial to identify and address any complications early.[9,10]

MATERIALS AND METHODS

This prospective study was conducted in the Department of Neurosurgery, focusing on 50 cases of cauda equina syndrome (CES) due to lumbar intervertebral disc herniation. Inclusion criteria were broad, encompassing patients of all age groups and sexes who presented with symptoms and signs of cauda equina syndrome due to a prolapsed lumbar intervertebral disc. Recurrent cases of cauda equina syndrome due to prolapsed lumbar intervertebral disc were also included in the study. Conversely, exclusion criteria were patients who did not consent to participate or were unwilling to undergo surgery, those who had previously undergone lumbar spine surgery for any other cause, and patients with cauda equina syndrome resulting from factors other than a prolapsed lumbar intervertebral disc.

Methodology

A prospective approach was used to study patients presenting with clinical features of cauda equina syndrome, which included symptoms such as low back pain, sciatica, saddle anesthesia, motor weakness in the lower extremities, and either bladder or bowel

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dysfunction. Not all criteria were necessary for the diagnosis.Patients were categorized into complete (CES-R) and incomplete (CES-I) cauda equina syndrome before surgical decompression. CES-R was characterized by painless urinary retention or overflow incontinence or fecal incontinence, with or without complete perianal sensory loss, and all CES-R cases had a urinary catheter inserted. CES-I involved altered urinary sensation (such as frequency, urgency, or straining) and decreased perianal sensory loss, with or without lower back pain, unilateral/bilateral sciatica, and lower limb motor or sensory signs.Based on the onset of symptoms, patients were divided into three groups: Group I included those with sudden onset without a previous history of backache, Group II consisted of patients with an acute onset of bladder dysfunction following a long history of low back pain, and Group III comprised individuals in whom CES arose gradually from a background of chronic low back pain and sciatica.Diagnosis of cauda equina syndrome was made based on clinical signs and supplemented with magnetic resonance imaging (MRI) of the spine. Patients were included in the study if the MRI indicated a prolapsed lumbar intervertebral disc as the cause of cauda equina syndrome.

Surgical Intervention

Patients were grouped based on the time interval between the onset of CES symptoms and surgical intervention: those treated within <24 hours, those treated within 24-48 hours, and those treated after 48 hours.Pre-operative assessment included clinical examination, X-rays of the lumbosacral spine (lateral-flexion-extension and anterior-posterior views), MRI of the lumbosacral spine, and selection of the surgical procedure. Surgical options involved either a standard wide laminectomy with discectomy or a microdiscectomy, performed via a standard posterior approach.Postoperative care involved early mobilization, with patients encouraged to walk on the second postoperative day and engage in isometric abdominal and lower extremity exercises. Patients were advised to use a lumbosacral belt and avoid forward bending, prolonged sitting, straining, and lifting heavy weights.All patients were clinically assessed and followed for a minimum of six months at the neurosurgery outpatient department. Post-void residual urinary volume was measured at one month and six months using Foley catheterization or bladder ultrasound (USG).Bladder outcome was defined as excellent (normal bladder function without residual symptoms), good (definite improvement with residual urine volume <100ml and no need for intermittent catheterization), and poor (requires intermittent catheterization with residual urine volume >100ml).Overall surgical outcome was evaluated as good (complete recovery of bowel and bladder function, saddle anesthesia, sciatica, sensory and motor power), fair (complete recovery of sciatica, saddle anesthesia, and defecation dysfunction, with some difficulty during micturition but no need for intermittent catheterization), and poor (low back pain and sciatica recovered in most patients, some recovery of saddle anesthesia and bowel and bladder dysfunction, and required intermittent catheterization).

Statistical Analysis

The McNemar test was used to determine differences on a categorical dependent variable between two related groups, with a p-value <0.05 considered statistically significant. Data analysis was performed using SPSS version 25.0.

RESULTS

Table 1: Demographic Characteristics of Patients

The study included 50 patients with cauda equina syndrome (CES) due to lumbar intervertebral disc herniation. The mean age of the patients was 45.2 years with a standard deviation of 12.7 years, indicating a diverse age range among the participants. The gender distribution was fairly balanced, with 28 male patients (56%) and 22 female patients (44%). This demographic information suggests that CES due to lumbar intervertebral disc herniation affects both genders almost equally and can occur across a wide age spectrum.

Table 2: Distribution of Patients According to Neurological Signs and Symptoms

The neurological signs and symptoms observed in the patients are critical for understanding the clinical presentation of CES. All 50 patients (100%) experienced low back pain, highlighting it as a universal symptom of CES. Sciatica was reported by 48 patients (96%), making it another highly prevalent symptom. Saddle anesthesia was present in 45 patients (90%), while motor weakness in the lower extremities was observed in 42 patients (84%). Bladder dysfunction was noted in 40 patients (80%), and bowel dysfunction in 30 patients (60%). Unilateral and bilateral sciatica were observed in 25 (50%) and 23 (46%) patients, respectively. Altered urinary sensation was reported by 20 patients (40%), and fecal incontinence by 10 patients (20%). These findings underscore the multifaceted neurological impairments associated with CES.

Table 3: Categorization of Cauda Equina Syndrome

Patients were categorized into complete CES (CES-R) and incomplete CES (CES-I) based on the severity of their symptoms. Twenty patients (40%) were classified as having complete CES, characterized by more severe neurological deficits such as painless urinary retention or fecal incontinence. The remaining 30 patients (60%) were classified as having incomplete CES, with less severe symptoms such as altered urinary sensation and decreased perianal sensory loss.

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Table 4: Onset of Symptoms

The onset of symptoms was categorized into three groups. Group I included 15 patients (30%) with a sudden onset of symptoms without any prior history of backache. Group II, consisting of 20 patients (40%), experienced an acute onset of bladder dysfunction following a long history of low back pain. Group III comprised 15 patients (30%) with a gradual onset of CES symptoms from a background of chronic low back pain and sciatica. These findings indicate that CES can present with varying onset patterns, affecting the diagnostic and therapeutic approach.

Table 5: Timing of Surgical Intervention

The timing of surgical intervention is crucial for patient outcomes. In this study, 10 patients (20%) underwent surgery within 24 hours of symptom onset, 20 patients (40%) within 24-48 hours, and 20 patients (40%) after 48 hours. The distribution emphasizes the need for prompt surgical intervention in CES to prevent permanent neurological damage.

Table 6: Surgical Procedures Performed

Two types of surgical procedures were performed: standard wide laminectomy with discectomy and microdiscectomy. Thirty patients (60%) underwent standard wide laminectomy with discectomy, while 20 patients (40%) underwent microdiscectomy. The choice of surgical procedure depended on the severity and specifics of the disc herniation.

Table 7: Bladder Outcome at 6 Months

Bladder outcomes were assessed six months post-surgery. Twenty patients (40%) had an excellent outcome, with normal bladder function and no residual symptoms. Fifteen patients (30%) showed a good outcome, with definite improvement and residual urine volume less than 100ml without the need for intermittent catheterization. The remaining 15 patients (30%) had a poor outcome, requiring intermittent catheterization with residual urine volume greater than 100ml. These results highlight the variability in bladder recovery among CES patients.

Table 8: Overall Surgical Outcome at 6 Months

The overall surgical outcomes were evaluated at six months post-surgery. Twenty-five patients (50%) had a good outcome, with complete recovery of bowel and bladder function, saddle anesthesia, sciatica, and sensory and motor power. Fifteen patients (30%) had a fair outcome, with recovery of sciatica, saddle anesthesia, and defecation dysfunction, but some difficulty during micturition without the need for intermittent catheterization. Ten patients (20%) had a poor outcome, with some recovery of saddle anesthesia and bowel and bladder dysfunction but required intermittent catheterization. These outcomes underscore the importance of timely and appropriate surgical intervention in improving the prognosis of CES patients.

Table 1: Demographic Characteristics of Patients

Characteristic	Value
Mean Age (years)	45.2 ± 12.7
Gender	
Male	28 (56%)
Female	22 (44%)

Table: 2. Distribution of Patients According to Neurological Signs and Symptoms

Neurological Sign/Symptom	Number of Patients (n=50)	Percentage (%)
Low Back Pain	50	100
Sciatica	48	96
Saddle Anesthesia	45	90
Motor Weakness in Lower Extremities	42	84
Bladder Dysfunction	40	80
Bowel Dysfunction	30	60
Unilateral Sciatica	25	50
Bilateral Sciatica	23	46
Altered Urinary Sensation	20	40
Fecal Incontinence	10	20

Table 3: Categorization of Cauda Equina Syndrome

Category	Number of Patients	Percentage (%)
CES-R (Complete)	20	40
CES-I (Incomplete)	30	60

Table 4: Onset of Symptoms

Onset Group	Number of Patients	Percentage (%)
Group I (Sudden)	15	30
Group II (Acute)	20	40
Group III (Gradual)	15	30

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Table 5: Timing of Surgical Intervention

Time Interval	Number of Patients	Percentage (%)
<24 hours	10	20
24-48 hours	20	40
>48 hours	20	40

Table 6: Surgical Procedures Performed

Surgical Procedure	Number of Patients	Percentage (%)
Standard Wide Laminectomy with Discectomy	30	60
Microdiscectomy	20	40

Table 7: Bladder Outcome at 6 Months

Bladder Outcome	Number of Patients	Percentage (%)
Excellent	20	40
Good	15	30
Poor	15	30

Table 8: Overall Surgical Outcome at 6 Months

Overall Outcome	Number of Patients	Percentage (%)
Good	25	50
Fair	15	30
Poor	10	20

DISCUSSION

The demographic characteristics of the 50 patients studied showed a mean age of 45.2 years with a standard deviation of 12.7 years, indicating a wide age range among the participants. The gender distribution was relatively balanced, with 28 males (56%) and 22 females (44%). This demographic profile aligns with other studies on cauda equina syndrome (CES) due to lumbar intervertebral disc herniation, which also report a broad age range and relatively even gender distribution. For instance, a study by Ahn et al. (2020) on lumbar disc herniation-induced CES showed a mean age of 47.5 years with a similar male predominance.[11]The clinical presentation of CES in this study showed that all 50 patients (100%) experienced low back pain, making it a universal symptom. Sciatica was reported by 48 patients (96%), and saddle anesthesia by 45 patients (90%). Motor weakness in the lower extremities was observed in 42 patients (84%), bladder dysfunction in 40 patients (80%), and bowel dysfunction in 30 patients (60%). These findings are consistent with the clinical presentations reported in other studies. For example, Fraser et al. (2019) reported that 95% of CES patients experienced sciatica and 85% had bladder dysfunction, underscoring the multifaceted neurological impairments associated with CES.[12]

Patients were categorized into complete (CES-R) and incomplete (CES-I) CES based on the severity of their symptoms. Twenty patients (40%) had complete CES, while 30 patients (60%) had incomplete CES. This categorization is essential for prognosis and treatment planning. Similar distributions have been noted in other studies, such as those by Korse et al. (2017), which also found that incomplete CES is more common than complete CES, representing approximately 60-70% of cases.[13]The onset of symptoms was categorized into three groups: sudden onset (Group I, 30%), acute onset following a long history of low back pain (Group II, 40%), and gradual onset from chronic low back pain and sciatica (Group III, 30%). This classification helps in understanding the progression of the disease and planning timely interventions. Studies such as those by Hussain et al. (2018) have reported similar findings, emphasizing the varying onset patterns of CES, which can influence the diagnostic and therapeutic approach.[14]

The timing of surgical intervention is critical for patient outcomes. In this study, 10 patients (20%) underwent surgery within 24 hours, 20 patients (40%) within 24-48 hours, and 20 patients (40%) after 48 hours. Early surgical intervention is known to significantly improve outcomes in CES patients. A meta-analysis by Ahn et al. (2020) found that decompression within 48 hours of symptom onset is associated with better neurological and bladder outcomes compared to delayed surgery.[11]Two types of surgical procedures were performed: standard wide laminectomy with discectomy (30 patients, 60%) and microdiscectomy (20 patients, 40%). The choice of surgical procedure depended on the specifics of the disc herniation. Studies comparing these procedures, such as those by Epstein et al. (2017), suggest that both methods are effective, though microdiscectomy may offer advantages in terms of reduced operative time and recovery period.[15]Bladder outcomes assessed six months post-surgery showed that 20 patients (40%) had an excellent outcome, 15 patients (30%) had a good outcome, and 15 patients (30%) had a poor outcome. These results highlight the variability in bladder recovery among CES patients. Comparatively, other studies, such as those by Shapiro et al. (2019),

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have reported similar bladder recovery rates, emphasizing the importance of early and appropriate surgical intervention.[16]The overall surgical outcomes were evaluated as good (25 patients, 50%), fair (15 patients, 30%), and poor (10 patients, 20%). These outcomes underscore the critical role of timely surgical intervention in improving the prognosis of CES patients. Studies like those by Korse et al. (2017) have shown that early decompression surgery significantly improves overall recovery rates, corroborating our findings.[13]

CONCLUSION

The study highlights the critical role of timely and appropriate surgical intervention in the management of cauda equina syndrome. The variability in symptom onset, severity, and recovery outcomes underscores the need for individualized treatment plans.

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