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Peri-operative Radiological Factors Predicting Outcome of Discogenic Cauda Equina Syndrome

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Abstract

Background Data: Acute cauda equina syndrome (CES) is a rare disorder considered as a neurosurgical emergency. It can be devastating in some circumstances. Outcome can be predicted by certain preoperative radiological and clinical items.

Purpose: To evaluate and analyse the effect of radiological criteria either pre- or postoperative on the final outcome of acute cauda equina syndrome.

Study Design: A prospective clinical case study on 27 patients who were presented by manifestations of CES from May 2014 to September 2017.

Patients and Methods: Between May 2014 to May 2017 a total of 27 consecutive patients with discogenic acute cauda equina syndrome underwent decompressive surgery (laminectomy and discectomy) with a follow-up at 6 and 12 months postoperative. Preoperative and postoperative clinical assessments were done by using Visual Analogue Scale (VAS) for analysing pain and full neurological examination. Surgical outcome was assessed using Oswestry Disability Index (ODI) and Japanese Orthopedic Association (JOA) scale. Recovery rate (RR) was calculated in final follow up for each patient. In all cases, preoperative and at the last follow-up control a neuro-radiographic MRI assessment was done**.** Level of affection, size and direction of prolapsed disc, presence of lumbar canal stenosis, degree of decompression (laminectomy), and the presence of disc residual disc, were all thoroughly analyzed with evaluating the correlation with clinical outcome.

Results: At final follow-up visit, we found that radiological factors had significant effect on the overall clinical outcome. L5-S1 disc level had the most favourable outcome when compared to other affected level. A statically significant correlation was found between degree of decompression and overall clinical improvement (P=0.001). Residual disc fragments had a direct relation to incomplete recovery from preoperative symptoms although statistically insignificant (P=0.93).

Conclusion: Full and thorough study of the pre- and postoperative radiological findings of the patients presented with discogenic cauda equina syndrome has an important prognostic value that can give a prediction for the surgical outcome and the overall clinical improvement. The degree of decompression and presence of canal stenosis was the most important outcome predictor factors. (2017ESJ148)

Keywords: Cauda equine; lumbar disc; radiology; outcome

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Introduction

Acute cauda equina syndrome (CES) is a condition due to damage or compression to the bundle of multiple lumbosacral nerve roots below the level of the conus medullaris. Symptoms include low back pain, pain that radiates down the leg, numbness around the anus, and loss of bowel and/or bladder control. It is uncommon and serious condition that is considered as an emergency that needs urgent surgical intervention to prevent a permanent neurological deficit.[2] This condition is usually caused by acute herniated lumbar disc although other causes such as trauma, tumor or inflammatory condition can be responsible for this syndrome.[9] Surgery has to be done as soon as possible, preferably within the first 48 hours of the beginning of symptoms.[6]

Discogenic acute cauda equina syndrome is the most common type and usually includes a huge disc herniation sometimes accompanied by underlying lumbar canal stenosis usually at L4-5 disc, but L3-4 and L5-S1 discs can also be the affected levels.[4,17] Prognosis for cauda equina syndrome is affected by many clinical factors such as time of onset at presentation, timing of surgery, severity of clinical manifestations and presentation by either a complete or a partial of the full clinical syndrome.[14]

Timing of surgery was the main point of discussion among authors describing acute cauda equina syndrome. Many preoperative and postoperative radiological findings were observed in cases with this syndrome. Whether these factors have an impact on the final prognosis of the condition or not? This issue was not solved in literature. This study aims to study and analyze the effect of radiological finding of acute cauda equina syndrome on the clinical outcome.

Patients and Methods

Patient Population:

This is a prospective clinical case study on patients with discogenic acute cauda equina syndrome (CES), who presented in our center with symptoms and signs of cauda equina compression. From May 2014 to May 2017, a consecutive series of 27 cases (18 males and 9 females) with CES were selected from a total of 572 patients (4.7%) operated for lumbar disc herniation in our institution. Exclusion criteria were all cases of pseudo cauda equina syndrome with negative MRI (i.e. Guillain–Barre syndrome, Transverse myelitis), or other causes of cauda equina syndrome compression rather than lumbar disc disease (tumor, trauma, infection, etc).

Clinical Assessment:

Clinical assessment was done on presentation and regularly on follow-up sessions. Low back pain and sciatic pain were assessed by Visual Analogue Scale. Full neurological examination was done; complete sensory examination including the saddle area with sensory grading: normal, hypopsethisa (impaired), and anesthesia (absent). Motor examination was done using British medical research council (MRC). Reflexes were classified as: hypo-reflexia, normal reflexes of exaggerated reflexes. Lumbar Japanese Orthopedic Association (JOA) Scale (29 points) and Oswestry Disability Index (ODI) were assessed preoperatively. Urinary function was categorized as: normal, partial retention, and complete retention that required catheterization. Bowel function on the other hand was classified as: normal, partial bowel dysfunction (constipation or incontinence), and complete dysfunction with loss of anal sphincter tension and reflexes. Sexual dysfunction was assessed in male only including: erectile dysfunction, decrease genital sensation, or priapism.

Radiological Assessment:

Preoperative MRI was done in all patients for definitive diagnosis; axial and sagittal T1 and T2 weighted images were done by 1.5 Tesla MRI (Philips Ingenia MRI system, USA). The following variables were thoroughly assessed, analyzed and categorized as Preoperative radiological factors such as:

(1) Level of affection. (2) Size and direction of prolapsed disc; size of the disc was measured in relation to the size of the canal. The size of the disc was measured in the maximum affected MRI cuts (The sagittal length of the hernia (A) and a line dividing the hernia into an anterior and a posterior half was selected (B) and used as the level for measurements in the transverse (right to left) direction were multiplied. This was divided on the size of the canal at the same level; (the anteroposterior (C) multiply the transverse measures (d)); [AB/CD %]. (Figure 1) We used disc herniation index instead of measuring

direct measurement of the disc herniation. In the present study we did not measure the absolute size of the hernia. We chose to describe the portion of the spinal canal occupied by a disc herniation. This way of measurement was presented by Thelander U ad et al,[24]. Regarding the direction of the hernia, it was classified as: central (opposite the disc space), upward migrated and downward migrated disc fragments. **(3) Presence of concomitant lumbar canal stenosis;** the anteroposterior diameter of the canal was measured relative the mean diameter of the canal or in relation to the standardized spinal canal diameters reported in literature [17]

Surgical Technique:

All patients were subjected to urgent surgery within few hours of admission. Surgical decision was taken after confirmation of the diagnosis of lumbar disc prolapse ± canal stenosis by MRI in all cases. Patients were operated in prone position. Surgical level is determined by X-ray images. After skin incision, muscle dissection was done to expose the laminae planned for decompression. Laminectomy was done in vertical and horizontal direction. Decompression laminectomy includes vertically half the height of the lamina above and below the stenotic area and horizontally down to the level of root foramina. All patients had laminectomy and bilateral foraminotomy. Full laminectomy was the standard technique; horse show laminectomy was done in 2 cases with wide transverse decompression. Three patients however had hemi-laminectomy only with limited bone removal. Large disc fragments usually need meticulous separation from nerve roots. Thorough searching for any missed fragment was done using different-sized hooks. Removal of intra-discal parts was also done in almost all cases. If the patient had spinal instability during surgery, posterior lumbar interbody fusion with fixation was decided; this was observed only in one patient. This patient had L4-5 disc prolapse and he was diagnosed before surgery to have spondylolysis without forward slippage. This was confirmed during surgery by mobile lamia and presence of significant movements at the pars interarticularis. This patient had full laminectomy, posterior lumbar interbody fusion by PEEK cages and allograft bone and short segment- transpediculoar fixation using titanium screws.

The closure was done in layers; drain was inserted for 1 day. Patients started ambulation within few hours of surgery. Patients commenced a physical therapy and rehabilitation therapy program post operatively, and this was continued in a spinal rehabilitation facility until the patient was regarded as independent. (Figure 2)

Assessment of Clinical and Radiological Outcome:

Follow-up was done at 6 months and 1 year postoperative. Clinical outcome was assessed by Visual Analogue Scale (VAS), lumbar Japanese Orthopedic Association (JOA) score (29 points), and Oswestry Disability Index (ODI) compared to preoperative results. Recovery rate was further assessed from JOA through the following equation: RR = (postoperative scores – preoperative scores)/ (29 - preoperative scores) *100%. It was subdivided into four categories: good (≥ 50%), moderate (10% ≤ RR <50%), poor (0 % ≤ RR <10%), and deteriorated when RR is less than 0%.[22]

Follow up MRI was done for all patients postoperatively at 12 months follow-up visit. The following postoperative radiological factors were assessed in the MRI images and correlated to clinical outcome: (1) degree of decompression (laminectomy) assessed by measuring the transverse and anteroposterior diameters of the laminectomy segment on MRI software, and (2) presence of residual disc fragments or protrusions.

Statistical Analysis

The Excel-sum test was used to analyze differences in the preoperative clinical and demographic characteristics (age, duration of symptoms) and in clinical outcome variables between groups (ODI score, JOA score, RR, and motor and sensory deficit improvement). Statistical significance was set at $P<0.05$. We used Pearson correlation for quantitative data, and we used Spearman correlation for qualitative data.

Results

In this study the mean age was 44.15±8.9 (Range, 33-57) years at time of presentation. All patients were admitted and operated with 24 hours of admission. At the time of surgery, patients' symptoms started

by a mean time of 4.9±2.92 (Range, 1-14) days. A total of 32 Levels were operated in the 27 patients; 22 patients had single level affection and decompression and 5 patients had double level decompression. L4-5 disc space was operated in 20 patients, L5-S1 was operated in 9 patients, and L3-4 in 3 patients.

Clinical Outcome:

Pain VAS: At final follow-up visit, clinical assessment was done and showed the following; According to Visual Analogue Scale; low back pain was improved from a mean of 5.26±1.16 (Range, 4-8) preoperatively to a mean of 5.4±1.45 (Range, 3-8) after surgery, 2.2±1.3 (Range, 1-6) at 6 months after surgery, and mean of 1.7±0.72 (Range, 1-3) after one year with P<0.001, (Table 3). For sciatic pain, it showed a more obvious improvement immediately after surgery; it had improved from a mean of 7.15±0.77 preoperatively to a mean of 2.67±1.49 immediately after surgery and to 2.26±1.06 at 6 months after surgery, and a mean of 1.81±0.74 at one year follow-up.

Motor affection: motor power was grade 5 in 74.1% of cases comparable to 7.4% before surgery according to MRC, (Table 1, 2). Preoperative motor power assessment: 25 patients (92.5%) had a certain degree of motor deficit. On the other hand only 2 patients (7.4%) had normal motor power (grade 5). Of the 25 patients who had motor deficit, 18 patients had bilateral weakness with multi-root affection; while 7 patients had unilateral affection (5 patients had weak dorsiflexion and 2 patients had multiple weaknesses). Postoperatively, there was significant improvement of the motor power form a mean of 2.7±0.91 (Range, 1-4) to a mean of 4.1±0.85 (Range, 3-5) at 6 months postoperatively and to a mean of 4.3±0.87 (Range, 3-5) at final follow up with 74% of patients had motor power grade 5. Only 7 patients had remaining motor deficit at final follow-up, 5 of them had severe weakness of foot dorsiflexion (grade 0), and 2 patients had grade III weakness.

Sensory affection: 23 patients suffered from sensory deficits in the form of dysesthesia, hypoesthesia or patches of anesthesia. Four patients however did not mention any sensory abnormality before surgery. Sensory affection showed poor degrees of improvement at final follow-up; saddle area hypoesthesia was delayed in improvement. Only 30 % of patients with sensory deficit (7 patients) had shown an improvement (4 patients with preoperative dysesthesia became normal, and 3 patients with sensor loss improved but still hypoesthesic). On the other hand, 70 % of those patients(16 patients) still complain of sensory disturbance in the previous forms at final follow-up visit 1 year after surgery, (Table 1, 2).The four patients who had no preoperative sensory affection had the same condition at final follow-up.

Urinary control: partial urinary retention was reported in 51.9% and complete urinary retention was found in 29.6%. Final follow-up; 18.5% patients still complained of residual bladder dysfunction following surgery. They were still in need of intermittent self-catheterization. They had a cystometrogram which showed persistent hypotonic bladder. The remaining 22 patients (81.5%) patients had no or very insignificant residual urinary symptoms with statistically significant correlation with early surgical decompression (P<0.05).

Bowel control: partial bowel dysfunction was reported in 18.5% and complete dysfunction was found in 7.4%. Final follow-up; 14.8% patients still complained of bowel dysfunction of varies degree with losing of anal sphincter tension and reflexes. Sexual dysfunction improved from 26% to 3.7% after surgery. (Table 1, 2)

Reflex changes: Most patients showed diminished ankle reflexes at final follow-up, sacral reflexes (bulbo-cavernous and anal wink)are also diminished significantly; Sacral reflexes were diminished in 23 of patients(85%) preoperatively, and It was also diminished in 22 of patients(82%) at final follow-up, with only one patient showed appearance of sacral reflexes compared as preoperative.

Three patients needed another surgery for removal of the missed disc fragment, one patient with mild superficial infection that was treated conservatively.

The overall satisfactory outcome at the final follow-up visits 1 year after surgery was reported in 88.9% of patients. One way ANOVA analysis of outcomes scales showed improvement in all scales (i.e. VAS, ODI, JOA, and RR) with P<0.001. (Table 5)

Radiological Outcome:

Level of affection: L4-5 disc space was operated in 20 patients (70%), L5-S1 was operated in 9 patients (33%), and L3-4 in 3 patients (11%). Clinical improvement was shown more obviously in patients with disc herniation at L5-S1; 77% (7 patients) of patients showed a satisfactory outcome at final follow-up visit rather than the other levels (statistically insignificant P=0.17); satisfactory outcome was shown in 65% for L4-5 and 67 % for L3-4.

Size of disc: Size of prolapsed disc was classified as huge and moderate sized disc (according to measurement method of Thelander U ad et al,[24]). There was no statistical correlation between the size of the herniated fragment and the overall outcome shown one year postoperatively. It appeared that disc fragment direction was related more to the canal stenosis degree with P<0.029, (Table 4) with the upward migrated fragment showed the worst canal diameter.[1,10] The clinical presentation (preoperative JOA and ODI scores) and other radiological factors like preoperative canal stenosis) seem to be more important outcome predictor than the size of the herniated disc even if it is of huge size.

Presence of canal stenosis: Antero-posterior diameter of the lumbar canal was measured in all patients preoperatively at the level of the affection. Diameter had an average measurement of 10.4±3.1 at L3-4 disc levels, 10.2±3.3 at L4-5 and 12.1±3.1 at L5-S1 disc. 88.9% of patients (N=24) presented as discogenic acute cauda equina syndrome was found to have concomitant lumbar canal stenosis. Canal compromise and stenosis were significantly correlated with JOA and RR surgical outcome (P=0.03 and P=0.02, respectively), (Table 4). All patients with poor final outcome at final follow-up visit had concomitant lumbar canal stenosis.

Degree of canal decompression: Spinal canal decompression was performed as mentioned in the surgical technique in vertical and horizontal directions. In certain cases (4 patients with lateral disc fragment herniation), decompression was directed for disc removal with limited bone removal. In 24 patients (88.9%) fair surgical decompression was reported in follow-up images (Table 2), while the other 3 patients showed limited decompression according to our decompression parameters discussed in Surgical Technique. A statistically significant correlation was found between the extent of laminectomy with wide surgical decompression and the overall clinical improvement in JOA scale and RR with P=0.001 (Table 4).

Residual disc fragments: Complete disc removal was achieved in 88.9% of patients (N=24), while in 3 patients a residual disc fragments –missed fragments- was shown in the postoperative MRI images. These did not need any further surgery. There was a statistically insignificant correlation (P=0.93) between presence or absence of residual disc fragments and the overall clinical outcome in all scales (i.e. VAS, ODI, JOA, and RR), showing worse outcome in those patients who had residuals in final MRI done. (Figure 3)

Residual disc fragments are not shown to affect the improvement of urinary and sphincter control. Its main affection was in the form of residual sciatica pain, sensory disturbances in the forms of dysesthesia and numbness.

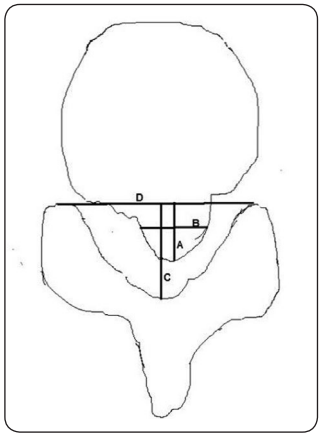

Figure 1. A diagram shows how measurement of the disc was done in our study. The size of the disc in the maximum MRI cuts was measured (The sagittal length of the hernia (A) and A line dividing the hernia into an anterior and a posterior half was selected (B) and used as the level for measurements in the transverse (right to left) direction were multiplied. This was divided on the size of the canal at the same level; (the antro-posterior (C) multiply the transverse measures (D), [AB/CD]. (Thelander U ad et al,[24])

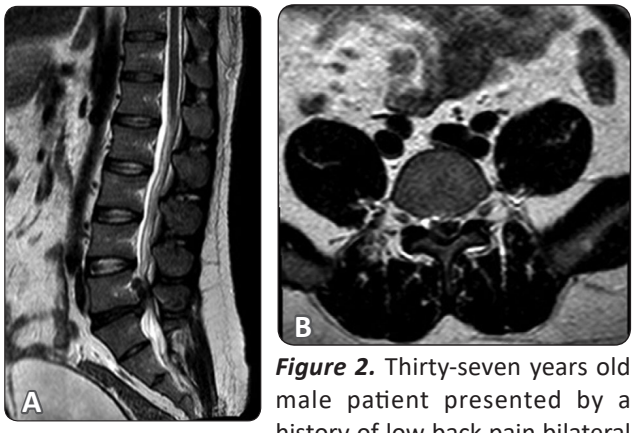

Figure 2. Thirty-seven years old male patient presented by a history of low back pain bilateral leg pain, right foot drop grade II, saddle are hypoesthesia. He was operated as urgent case within 48 hours of onset of symptoms. (A, B) Preoperative sagittal and axial T2 weighted image showing huge L5-S1 disk herniation with upward migration with relative at that level. (C) Postoperative sagittal and axial T2 weighted images showing complete removal of the disc fragment with adequate canal decompression.

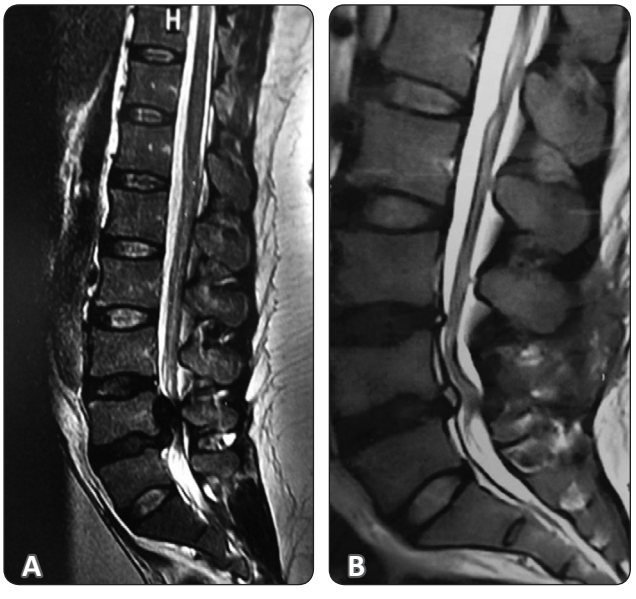

Figure 3. Forty-six years old female presented by bilateral foot drop with weakness of right lower limb proximal and distal. (A) Preoperative sagittal MRI showing huge upward migrated L45 disk propels comprising the whole cauda equina. (B) Postoperative sagittal MRI shows residual disk herniation. The patient had incomplete resolution of the preoperative clinical signs.

Table 1. Preoperative Demographic and Clinical Characteristics of Study Patients

Variable		No.	Percent
Sex	Male	18	66.7
	Female	9	33.3
Pain	Back pain	2	7.4
	Unilateral Sciatica	10	37.0
	Back pain and Sciatica	9	33.3
	Bilateral Sciatica	6	22.2
	Total	27	100.0
Sensory	Normal	4	14.8%
	Impaired	19	70.4 %
	Absent	4	14.8%
	Total	27	100.0
MRC	G5	2	7.4
	G4	9	33.3
	G3	6	22.2
	G2	6	22.2
	G1	3	22.2
	G0	1	3.7
	Total	27	100.0
Urine	Normal	5	18.5
	Partial retention	14	51.9
	Complete retention	8	29.6
	Total	27	100.0
Defection	Partial bowel dysfunction	5	18.5
	Complete dysfunction	2	7.4
	Normal	20	74.0
	Total	27	100.0
Sex	Sexual dysfunction	7	26.0
	Normal	20	74.0
	Total	27	100.0
Comorbidity	Hypertension	4	14.8
	Diabetes	2	7.4
	Both	3	11.1
	Smoke	5	18.5
	Total	14	51.9
Level	L4/5	15	55.6
	L5/S1	7	25.9
	L3/4-L4/5	3	11.1
	L4/5-L5/S1	2	7.4
	Total	27	100.0
Canal compromise	0–25%	1	3.7
	26–50%	2	7.4
	51–75%	10	37.0
	76–100%	14	51.9
	Total	27	100.0
Disc prolapsed	Caudal migration	12	44.4
	Cranial migration	4	14.8
	Posterior migration	3	11.1
	Diffuse disc bulge	8	29.6
	Total	27	100.0

MRC; Medical Research Council

Table 2. Postoperative Radiographic and Clinical characteristics of Study Patients

Variable		No.	Percent
Sensory	Normal	8	29.6
	Impaired	18	66.7
	Absent	1	3.7
	Total	27	100.0
MRC	G5	20	74.1
	G4	2	7.4
	G3	3	11.1
	G2	1	3.7
	G1	1	3.7
	G0	0	0
	Total	27	100.0
Urine	Normal	22	81.5
	Partial retention	3	11.1
	Complete retention	2	7.4
	Total	27	100.0
Defection	Partial bowel dysfunction	2	7.4
	Complete dysfunction	2	7.4
	Normal	23	85.2
	Total	27	100.0
Sex	Sexual dysfunction	1	3.7
	Normal	26	96.3
	Total	27	100.0
Recovery rate (RR)	≥ 40	2	7.4
	≥ 50	1	3.7
	≥ 60	4	14.8
	≥ 70	4	14.8
	≥ 80	12	44.5
	≥ 90	4	14.8
	≥ 100	27	100.0
Canal decompression	Adequate	24	88.9
	Inadequate	3	11.1
	Total	27	100.0
Complication	No.	23	85.2
	Superficial infection	1	3.7
	Recurrent disc	3	11.1
	Total	27	100.0

MRC, medical research council

Table 3. Distribution of Patient's Age, Timing of Surgery, Preoperative and Post-Operative Clinical Data (WAS, ODI, JOA, and RR), and Canal Compromise

Variables	Mean±SD
Age (years)	44.15 ±8.9
Canal compromise (%)	83.3 ±.79
VAS back pre	5.26 ± 1.16
VAS back early	5.4 ± 1.45
Vas back– 6 months	2.2 ± 1.3
Vas back late	1.7 ± 0.72
VAS sciatica pre	7.15 ±0.77
VAS sciatica early	2.67 ±1.49
Vas sciatica– 6 months	2.26 ±1.06
Vas sciatica late	1.81 ±0.74
ODI pre	40.1 ±7.57
ODI early	17.0 ±4.22
ODI– 6 months	13.8 ± 3.4
ODI late	13.6 ±4.15
JOA pre	7.1 ±1.59
JOA early	16.6 ±2.68
JOA– 6 months	23 ± 2.45
JOA late	24.4 ±2.22
RR early	42.06±13.82
RR– 6 months	69.4± 11.23
RR late	78.9 ±10.52
Time of surgery/day	4.9 ±2.92

VAS; Visual Analogue Scale, ODI; Oswestry Disability Index, JOA; Japanese Orthopedic Association Scale, RR; Recovery Rate

Table 4. Bivariate Analysis of Image, and Surgical Outcome Explaining the Variable, the Correlation and Its Significance

Variable	Variable	P value*	Correlation	Interpretation
Canal compromise	Disc material	0.003	0.550^{s}	Strong
Canal compromise	JOA out late	.032	0.414^{p}	poor
Canal compromise	RR	0.029	0.422^{s}	poor
Canal decompression	JOA out late	0.001	-0.606^{p}	Strong
Canal decompression	RR	0.005	0.500^{s}	Moderate
VAS out late	ODI out late	<0.001	0.779^{p}	Strong

VAS: Visual Analogue Scale, ODI: Oswestry Disability Index, JOA: Japanese Orthopedic Association Scale, RR: Recovery Rate

S: Spearman correlation (qualitative data)

* P value significance < 0.05

P: Pearson correlation (quantiative data)

Table 5. Long Term Surgical Outcome Recovery (Multivariate ANOVA test)

Multivariate Tests[a]									
Effect		Value	F	Hypothesis df	Error df	Sig.	Partial Eta Squared	Noncent. Parameter	Observed Power[d]
Intercept	Pillai's Trace	0.991	2944.197[b]	3.000	76.000	.000	.991	8832.591	1.000
	Wilks' Lambda	0.009	2944.197[b]	3.000	76.000	.000	.991	8832.591	1.000
	Hotelling's Trace	116.218	2944.197[b]	3.000	76.000	.000	.991	8832.591	1.000
	Roy's Largest Root	116.218	2944.197[b]	3.000	76.000	.000	.991	8832.591	1.000
Group	Pillai's Trace	1.338	51.860	6.000	154.00	.000*	.669	311.160	1.000
	Wilks' Lambda	0.043	96.977[b]	6.000	152.00	.000*	.793	581.862	1.000
	Hotelling's Trace	13.434	167.930	6.000	150.00	.000*	.870	1007.580	1.000
	Roy's Largest Root	12.738	326.932[c]	3.000	77.00	.000*	.927	980.795	1.000

P value significance < 0.05

Discussion

Acute cauda equina syndrome is an uncommon disorder that constitutes 1-5 % of spinal disease.[11,19] The most common presentation is saddle area hypoesthesia, urinary incontinence and motor deficits.[3,12,16] The pathogenesis of this condition is still controversial but it can be explained by nerve damage due to direct mechanical compression or by vascular insult as ischemia or venous congestion.[23] Surgical intervention is considered the cornerstone in management of this catastrophic condition. Early surgical intervention was shown to be very important factor in determining the prognosis for such condition.[21] Optimal timing has a controversy, some authors recommend urgent surgery within 24 hours to achieves a satisfactory outcome,[13] while others mentioned up to 3 days is allowed to achieve the same results.[5,15] Other author[7] reported a significantly positive correlation between duration taken for total recovery and delay in surgery and that the recovery in cauda equina patients can take an exceptionally long time and hence should involve in constant reassurance and rehabilitation of the patient.

Our study was based on evaluation of the radiological factors that can affect the final outcome in cauda equina syndrome. Most studies assessed the outcome of decompression regarding timing of surgery and preoperative clinical criteria. Because of the paucity of literatures discussing the issue of radiological factors, we will discuss our results but limited comparative analysis.

We found that more satisfactory results were achieved when the affected level was L5-S1 disc level rather than other levels which showed worse outcome. This can be explained by the usual wide canal at that level. These results were not matching with other studies that showed no significant difference in outcome between L4-5 and L5-S1 disc levels after surgery.[18]

We found a strong relationship between the overall neurological improvement and the presence or absence of lumbar canal stenosis preoperatively. There was significant improvement in those patients with no preoperative lumbar canal stenosis. All patients with poor final outcome at final follow-up visit had concomitant lumbar canal stenosis. Some authors[8,14,17] found in their work about MRI results in acute cauda syndrome that a significant smaller anteroposterior diameter of the lumbar spinal canal is usually presented in patients with cauda equina syndrome. They also reported that diameters of CES patients were significantly more often below average than that of the sciatica patients.

In this study the degree of surgical decompression either limited or wide decompression had a significant effect on the overall outcome using JOA scale (P<0.001). We found a strong statistically significant correlation between the degree of decompression and the degree of final RR improvement (P<0.001). This can lead us to suggest a full laminectomy in cauda equina cases even if the

pathology is purely discogenic only without lumbar canal stenosis. Other similar studies[17,25,26] reported more or less similar results where the reported positive correlation between clinical outcome and the degree of lumbar canal decompression.

There was a statistically significant correlation between the size of herniated disc material and the degree of canal stenosis (P<0.029), however, there was no correlation between the size of the herniated fragment and the overall clinical outcome at final follow-up . In comparison to canal stenosis, the degree of disc removal or residual had no significant relation to surgical outcome scales with (P>0.2). Shapiro[20] in his study showed a 64% of his patient had a massive and huge disc prolapse to present with cauda equina syndrome, with no correlation to final outcome

In some of our patients as reported in our results, follow-up MRI at final visit showed residual disc fragments, this was expected to be either not completely removed from the first surgery or developed as a new disc bulges shortly after surgery.

In our study, we assessed some radiological factors in comparison to clinical outcome in a serious condition. The strong and novel point of this study is that it predicts the outcome according to radiological factor, a point that is not discussed clearly in previous literatures. Our preliminary results need to be confirmed by larger series with long term follow-up.

Conclusion

Full and thorough study of the pre- and postoperative radiological findings of the patients presented with discogenic cauda equina syndrome has an important prognostic value that can give a prediction for the surgical outcome and the overall clinical improvement**.** The degree of decompression and presence of canal stenosis was the most important outcome predictor factors.

References

1. Abouelmaaty E H, EL Molla S: Reliability (Revalidation) of MSU MRI Classification of Lumbar Disc Herniation in 100 Patients Series: Severity and Objective Surgical Criteria. Egyptian Spine Journal 17:5-16, 2016
2. Ahn UM, Ahn NU, Buchowski JM, Garrett ES, Sieber AN, KostuikJP: Cauda equina syndrome secondary to lumbar disc herniation—A meta-analysis of surgical outcomes. Spine 25(12):1515–22, 2000
3. Aho A, Auranen A, Pesonen K: Analysis of cauda equina syndrome in patients with lumbar disc prolapse. Preoperative and cystometric studies. Acta Chir Scand 135:413–420, 1969
4. Amundsen T, Weber H, Lilleas F, Nordal HJ, Abdelnoor M, Magnaes B: Lumbar spinal stenosis. Clinical and radiologic features. Spine 20:1178–86, 1995
5. Delamater RB, Sherman JE, Carr JB: Cauda equina syndrome. Neurological recovery following immediate, early or late decompression. Spine 16:1022–1029, 1991
6. DeLong WB, Polissar N, Neradilek B: Timing of surgery in cauda equina syndrome with urinary retention: meta-analysis of observational studies. J Neurosurg Spine 8(4):305–20, 2008
7. Dhatt S, Tahasildar N, Tripathy ST, Bahadur R, Dhillon M: Outcome of spinal decompression in cauda equina syndrome presenting late in developing countries: case series of 50 cases. Eur Spine J 20(12):2235–2239, 2011
8. El Barzouhi A, Verwoerd AJH, Peul WC, Verhagen AP, Lycklama a, Nijeholt GJ, et al: Prognostic value of magnetic resonance imaging findings in patients with sciatica. J Neurosurg Spine24:978–85, 2016
9. Fraser S, Roberts L, Murphy E: Cauda equina syndrome: a literature review of its definition and clinical presentation. Arch Phys Med Rehabil 90(11):1964–68, 2009
10. Hamada S, Abou-Zeid A H: Clinical and Surgical Correlation with MRI Findings in Herniated Lumbar Disc: Towards Clinical and Surgical Application of the Current Classification

Oriented Understanding of the Morphology of the Herniated Lumbar Disc. Egyptian Spine Journal 14:32-45, 2015
11. Jennett WB: A study of 25 cases of compression of the cauda equina by prolapsed intervertebral discs. J Neurol Neurosurg Psychiatry 19:109, 1956
12. Jones DL, Moore T: The types of neuropathic bladder dysfunction associated with prolapsed lumbar intervertebral disc. Br J Urol 45:39–43, 1973
13. Kennedy J, Soffe K, McGrath A, Stephens M: Predictors of outcome in cauda equina syndrome. Eur Spine J 8:317–322, 1999
14. Korse NS, Pijpers JA, van Zwet E, Elzevier HW, Vleggeert-Lankamp CL: Cauda equina syndrome: presentation, outcome and predictors with focus on micturition, defecation and sexual dysfunction. Eur Spine J 26(3):894–904, 2017
15. Kostuik JP, Harrington I, Alexander D: Cauda equina syndrome and lumbar disc herniation. J Bone Joint Surg [Am] 68:386–391, 1986
16. Little JG, DeLiss JA: Cauda equina injury: late motor recovery. Arch Phys Med Rehabil 67:45–47, 1986
17. Nina SKNS, Mark CK, Wilco CP: Lumbar spinal canal MRI diameter is smaller in herniated disc cauda equina syndrome patients. PLoS One 12(10.1371), 2017
18. Okoro T, Sell P: A short report comparing outcomes between L4/L5 and L5/S1 single-level discectomy surgery. J Spinal Disord Tech 23(1):40-2, 2010
19. Shapiro S: Cauda Equina Syndrome secondary to lumbar disc herniation. Neurosurgery 32 :743–747, 1993
20. Shapiro S: Cauda equina syndrome secondary to lumbar disc herniation. Neurosurgery 32(5):743-6 (discussion) 746-7, 1993
21. Shepard RH: Diagnosis and prognosis of cauda equina syndrome produced by protrusion of lumbar disc. BMJ 2(5164):1434–1439, 1959
22. Si-Dong Yang, Feng Zhang, Wen-Yuan Ding: Analysis of clinical and neurological outcomes in patients with cauda equina syndrome caused by acute lumbar disc herniation: a retrospective-prospective study. Onco target 8(48):84204-84209, 2017
23. Spector LR, Madigan L, Rhyne A, Darden B 2nd, Kim D: Cauda equina syndrome. J Am Acad Orthop Surg 16(8):471-9, 2008
24. Thelander U, Fagerlund M, Friberg S: Size of Lumbar Disc Hernias Measured Using Computed Tomography and Related to Sciatic Symptoms. Acta Radiologica 31(6):555-558, 1990
25. Todd NV: Cauda equina syndrome: the timing of surgery probably does influence outcome. Br J Neurosurg 19(4):301–6, 2005
26. Türkoğlu E, Karavelioglu E, Oral N, Sanli AM, Şekerci Z: Cauda equina syndrome due to posterior squestered lumbar disc herniation: A Rare Case Report And MRI Findings. The journal of Turkish spinal surgery 24(2):165-168, 2013

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الملخص العربي

عوامل الإشعة قبل التخل الجراحي التي تتنبأ بنتائج متلازمة ذيل الفرس الحاده

البيانات الخلفيه: متلازمة ذنب الفرس الحادة هو اضطراب نادر يعتبر طارئًا في جراحة الأعصاب. يمكن التنبؤ بالنتائج عن طريق بعض العناصر الإشعاعية والسريرية قبل الجراحة.

الغرض: لتقييم وتحليل تأثير المعايير الإشعاعية إما قبل أو بعد العملية الجراحية على النتيجة النهائية لمتلازمة ذيل الفرس الحادة.

تصميم الدراسة: دراسة استطلاعية على 27 مريضا تم تقديمهم من خلال مظاهر CES من مايو 2014 إلى سبتمبر 2017

المرضي والطرق: ما مجموعه 27 مريضا متتالية مع متلازمة ذنب الفرس الحادة قد خضعوا لعملية إزالة الضغط (استئصال الصفائح و الغضروف المنزلق) مع المتابعة في 6 و 12 شهرا فترات ما بعد الجراحة. وقد أجريت التقييمات السريرية قبل الجراحة وبعد العملية الجراحية باستخدام مقياس التناظرية البصرية (فاس) لتحليل الألم، والفحص العصبي الكامل. تم تقييم النتائج الجراحية باستخدام مؤشر الإعاقة أوزويستري (أودي) وجمعية العظام اليابانية (جوا). تم حساب معدل التحسن في المتابعة النهائية لكل مريض. في جميع الحالات، تم إجراء تقييم الأشعة العصبية (دراسة التصوير بالرنين المغناطيسي) قبل الجراحة، وفي آخر متابعة مراقبة. وقد تم تحليل بعض العوامل الإشعاعية مثل؛ وقد تم تحليل مستوى الانزلاق وحجم واتجاه الغضروف المنزلق ، وجود تضيق القناة القطنية الشوكية، ودرجة الضغط (استئصال الصفائح)، ووجود الانزلاق الغضروفي المتبقي، مع تقييم العلاقة مع النتيجة السريرية.

النتائج: في زيارة المتابعة النهائية، لاحظنا أن العوامل الإشعاعية كان لها تأثير كبير على النتيجة السريرية الشاملة. وأظهر مستوى القرص L5-S1 النتيجة الأكثر ملاءمة عندما كان المستوى المتضرر. وتم العثور على ارتباط ذو دلالة إحصائية بين درجة تخفيف الضغط والتحسين السريري الكلي (P = 0.001). كانت شظايا القرص المتبقية في المتابعة النهائية لها علاقة مباشرة بالتحسن غير المكتمل من الأعراض قبل الجراحة ولكنها كانت غير ذات دلالة إحصائية (P> 0.2).

الاستنتاج: الدراسة الكاملة والدقيقة للنتائج الإشعاعية قبل وبعد العملية الجراحية للمرضى المصابين بمتلازمة ذنب الفرس الحادة الغضروفيه تحظي بقيمة تنبؤية هامة والتي يمكن أن تعطي تنبؤاً بالنتائج الجراحية والتحسين السريري العام.