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CLINICAL EFFECTIVENESS OF SINGLE LUMBAR PERIRADICULAR INFILTRATION IN PATIENTS WITH SCIATICA

Dimitar Veljanovski[1], Sandra Dejanova Panev[1], Masha Kostova[1], Daniela Ristikj-Stomnaroska[2], Tatjana Deleva Stoshevska[2], Petar Janevski[3], Smiljana Bundovska Kocev[3], Biljana Prgova[1]

[1] Department of Radiology, General City Hospital "8-mi Septemvri" Skopje, RN Macedonia

[2] Department of Neurology, General City Hospital "8-mi Septemvri" Skopje, RN Macedonia

[3] Department of Radiology, University Clinic "Mother Theresa", Skopje, RN Macedonia

Corresponding author: Dimitar Veljanovski, MD,PhD E-mail: dimitar.veljanovski@gmail.com, Phone: + 389 70 667 222

ABSTRACT

Periradicular therapy (PRT) is a minimally invasive radiological procedurein patients with chronic lumbar pain.The aim of the study is to identify clinical and radiological predictive factors for treatment success after a single PRT treatment in patients with sciatica.The study includes a prospective follow-up of 166 patients treated with PRT. The pain intensity is determined according to the VAS scale and the degree of improvement is presented as excellent (over 75%), good (50-70%), moderate (25-49%), and weak (less than 25%). The follow up of the treated patients was done at 2 weeks, 3 and 6 months. In patients with pain duration up to 3 months, the improvement was excellent in n=32 (58.18%) after 2 weeks, after 3 months n=41 (74.55%) and after 6 months n=41 (74.55%). This stands in contrast to patients with pain over 1 year. The percentage of improvement after 6 months, post-intervention, was highest in patients without nerve root compression (86.25±19.2),and the highest improvement after 6 months was in patients with localization of pain at the L4-L5 level (69.69±29.7), the greatest improvement after six months was in patients with extraforaminal hernia (62.82±34.3), and the lowest in patients with central stenosis (40.21±30.7).Our study results suggest that the shorter a pain duration, low-grade root compression, injection level and type of herniation area predictor the more favourable response patients have to transforaminal epidural steroid injection in patients with sciatica.

Keywords: epidural, radiculopathy, pain, MRI, steroid

INTRODUCTION

Sciatica occurs in app. 80% of the population, at least once in a lifetime [1]. Chronic sciatica followed by lumbar pain and radiculopathy are clinical syndromes which include sensory or motor deficiency of the affected parts, lasting longer than 12 weeks [2]. For this condition, less invasive techniques, including periradicular therapy (PRT) as non-vascular interventions are usually used.The condition in which this method is useful is chronic pain of the spine due to disc herniation, disc swelling, or degenerative changes. By this technique, a cocktail of anaesthetic and corticosteroid is injected into the lateral epidural space or around the nerve radix, under CT (Computerised Tomography) monitoring. This leads to the inhibition of inflammatory mediators and reduces the pain level [3, 4].The aim of the study was to identify clinical and radiological predictive factors in PRT treatment in patients with sciatica.

MATERIAL AND METHODS

The study was prospective and non-randomised, with 166 subjects – male (n=90) and

female (n=76). Patients with chronic lumbar or radicular painwere included. The age of the patients ranged from 21 to 83 years (57.3±13.4 years) with an average length of pain duration of 8.3±6.9 months. All patients underwent MRI (magnetic resonance imaging) at least one month prior to the intervention with central canal stenosis, spondylolisthesis, and disc herniation, with or without nerve root compression. A subcutaneous application of Lidocaine (3ml), as well as Bupivacaine (2ml) and Kenalog (2ml) at the level of the lateral epidural space, was used in all patients. The application of the medicine (Bupivacaine and Kenalog) was monitored using a 16-slice CT scanner.The level of pain intensity was scored according to the VAS scale (Visual Analogue Scale) including mild, moderate, severe, and very severe pain. Depending on the pain duration, patients were divided into 4 groups: I - up to 3 months;II - from 4 to 6 months;III - from 7 to 12 months; and IV - over a year. The level of improvement was presented as excellent (over 75%), good (50-70%), moderate (25-49%), and poor (less than 25%). The functional and work status was rated according to the Oswestry Disability Index 2.0 (ODI). After the intervention was performed, the follow-up of the patients was done in the 2nd week, in the 3rdmonth and in the 6th month.Inclusion criteria for the study were: radiculopathy lasting at least 4 weeks under conservative treatment, clinically and radiologically (MRI) diagnosed lumbar radiculopathy (disc herniation and mechanical compression of the radix). Exclusion criteria were allergies, pregnancy, absence of radix compression by MRI examination, other pathological conditions that can have identical symptoms, anticoagulant treatment, and metabolic radiculopathy. Prior to PRT, the decision for the treatment was based on the Advisory committee opinion(neurologist, neurosurgeon and radiologist). Laboratory analysis and hemostasis tests were performed on all patients.For the treatment, insulin, 18 G and Chiba needles were used. The analysis of radiological characteristics, type, morphology of the disc herniation, side, and level at which the nerve root was affected were classified using the Fardon I Milet,te system, and the combined task force classification. The MRI scan protocol included T2-sequencing in the sagittal and transverse planes, T1-sequencing in the sagittal plane and TIRM T2 in the sagittal plane, with fat tissue suppression.

Technique for performing treatment. For maximum accuracy and superior anatomical orientation and minimal complications, the procedure was performed under the CT device. Before the intervention, an informed consent form was given to the patients. They were in the CT scan in a prone position. A puncture site was defined by a wire marker - line median on a skin surfacefollowed by CT scan and a 2mm thin incision as an area of application. Local anaesthesia, Lidocaine app. of 3ml, was gently applied by a thin needle, ,introduced subcutaneously, followed by an 18 G needle, which proceeds internally with CT support and a quick scan. Under CT sequencing, additional longer needle (Chiba) is used to penetrate into the deeper layers. A good positioning of the needle is when the tip is at the lateral epidural space placed periradicular and closest to the nerve root. An anaesthetic (Bupivacaine 3ml) and then a corticosteroid (Kenalog 2ml) were slowly administered. The intervention ended by removing the needle and administering a local dressing that remained for 24 hours. The patients were monitored for 2 hours after the intervention. The average time of intervention in this study was 16 minutes. During or after the intervention, 20% of the patients experienced a transient neurological deficit that included mild pain, paraesthesia and weakness on the side of the affected and treated radix. It lasted a maximum of 8-12 hours, with complete disappearance. Nerve root damage during the intervention, puncture of subarachnoid space, soft tissue and blood vessel damage, or prolonged bleeding were not observed during the study.

Statistical analysis.For the statistical analysis, SPSS 23.0 Kolmogorov-Smirnov test and Shapiro Wilk's test were used. For the comparison of the examined patient groups the following parametric and non-parametric tests were used: Chi-square test, Fisher exact test, Analysis of Variance, Mann-Whitney test, Kruskal-Wallis test.For the comparison of certain variables of the examined times, the following non-parametric tests for dependant samples were used: Friedman ANOVA, Wilcox on matched pairs. The non-parametric correlation (Spearman's coefficient) was used to consider the relation between the pain duration and variables of interest.The Odd Ratio and 95% Confidence Interval as a multivariant logistic regression analysis were used to determine the predictors of the 6-month pain reduction. Statistical significance was defined as $p < 0.05$.

RESULTS

More patients included in the study had no previous surgical intervention and the lumbar pain was felt mostly on the left side of the body (Table 1).

Table 1. *Previous surgical interventions and pain side of patients*

Variable	
Previous surgical intervention n (%)	
Yes	27 (16.27)
No	139 (83.73)
Side n (%)	
Right	56 (33.73)
Left	66 (39.76)
Bilateral	29 (17.47)
Spondylolisthesis	15 (9.04)

The majority of the patients had severe pain – 46.4% (n=77). In 50% of the patients, the pain intensity was scored 5 at a scale from 1 to 10. (Table 2).

Table 2. *Pain intensity*

Pain intensity (VAS)	
Very severe / n (%)	31 (18.67)
Severe / n (%)	77 (46.38)
Moderate / n (%)	54 (32.53)
Mild / n (%)	4 (2.41)
Pain score n (%)	
mean±SD	5.07±1.9
median (IQR)	5 (2 – 9)

The average duration of the pain was 8.3±6.9 months, the shortest pain duration was 1month, and the longest duration was 36 months; The percentage of 21.1% (n=35) of the patients had pain longer than 12 months(Table 3).

Table 3. *Duration of the lumbar pain*

In months	
0-3 / n (%)	55 (33.13)
4 – 6 / n (%)	34 (20.48)
7 – 12 / n (%)	42 (25.3)
> 12/n (%)	35 (21.08)
(mean ± SD) (min-max)	(8.3±6.9) (1 – 36)
median (IQR)	6.0 (3.0 – 12.0)

Table 4. *Average VAS in time intervals*

Pain duration (months)	Improvement					p-value
	Excellent n(%)	Moderate n(%)	Good n(%)	Mild n(%)	Operated on n (%)	
2 weeks						
0 – 3	32 (58.18)	11 (20)	9 (16.36)	3 (5.45)		X2= 34.62
4 – 6	13 (38.24)	8 (23.53)	10 (29.41)	3 (8.82)		p = 0.00007 sig
7 – 12	10 (23.81)	12 (28.57)	14 (33.33)	6 (14.29)		
> 12	2 (5.71)	14 (40)	9 (25.71)	10 (28.57)		
3 months						
0 – 3	41 (74.55)	4 (7.27)	7 (12.73)	3 (5.45)	0	X2= 86.15
4 – 6	17 (50)	3 (8.82)	6 (17.65)	5 (14.71)	3 (8.82)	p = 0.00000 sig
7 – 12	8 (19.05)	18 (42.86)	11 (26.19)	2 (4.76)	3 (7.14)	
> 12	2 (5.71)	11 (31.43)	6 (17.14)	16 (45.71)	0	
6 months						
0 – 3	41 (74.55)	3 (5.45)	6 (10.91)	4 (7.27)	1 (1.82)	X2= 79.49
4 – 6	15 (44.12)	6 (17.65)	5 (14.71)	3 (8.82)	5 (14.71)	p = 0.00000 sig
7 – 12	8 (19.05)	13 (30.95)	9 (21.43)	9 (21.43)	3 (7.14)	
> 12	2 (5.71)	7 (20)	3 (8.57)	21 (60)	2 (5.71)	

p <0.05 (Pearson Chi-square)

There was a significant pain reductionin the patients, depending on the localisation of pain (p = 0.014), six months after the intervention. This was due to a significantly better outcome in the patients with localisation of pain at the L4-L5 level compared to patients with pain at the L5-S1 level (p = 0.077) (Table 5).

Table 5. *Level of pain*

Level of pain (localisation)	improvement in %	
	N	mean±SD
6 months after intervention		
L3-L4	22	55.91±33.4
L4-L5	82	69.69±29.7
L5-S1	48	51.52±30.1
L2-L3	3	53.33±40.4

After the 6th month of intervention, the patients with posterolateral and extraforaminal disc herniation showed the highest pain reduction (Table 6).

Table 6. *Theherniated disc position related to pain reduction*

Position of the herniation	Pain reduction in %	
	n	mean±SD
After 6thmonths		
Posterolateral	36	64.86±33.2
Foraminal	41	57.07±26.8
Extraforaminal	39	62.82±34.3
Central stenosis	24	40.21±30.7

The level of nerve root compression had a great impact on patient improvement($p<0.0001$). In none of the patients with 4th level of compression, 42.3% had great outcomes 6 months after the intervention. The patients with 1st level of root compression had excellent improvement – 58.9% (table 7).

DISCUSSION

Epidural applications have been used intensively since 1952 and are still an integral element in the non-surgical management of chronic lumbar pain and radiculopathy [5]. The main objective of minimally invasive interventions is to reduce the pain level, which, in combination with conservative therapy,leads to long-term effects. [6]

Many studies provided strong evidence for the effectiveness of lumbar transforaminal applications over a short period of time [7, 8, 9]. Thus, they have shown that administering topical anaesthetics and corticosteroids can provide pain reduction [10]. Mechanical compression of the nerve root with consecutive mechanical radiculitis plays an essential role in the development of lumbosciatic pain [11]. Radicular pain is caused by inflammation of the nerve root, resulting from an inflammatory response to the herniated disc material, confirmed by several studies. [12, 13, 14]. Thus, transforaminal epidural applications are effective in the treatment of chronic lumbar and radicular pain [15, 16, 17]. In general, there is an increase in minimally invasive techniques for the non-surgical management of lumbosciatic pain [18]. This study aims to determine the predictive factors that may influence the treatment. According toInman et al. [19], gender was not a predictor for the successful treatment for pain reduction, confirmed by the several studies [20, 21, 22]. In our study, no significant correlation between patient age and improvement afterthe intervention was found.In the study by Lee et al. [23], the average age of patients demonstrating better success was higher compared to the younger population. This could be explained by the anatomorphological consistency and numerous components of the nucleus in the younger population, associated with a stronger inflammatory reaction leading to prolonged persistent pain [24]. Our

Table 7. *Improvement in patients with different levels of nerve root compression*

improvement	n	Level of nerve root compression				
		0 n(%)	1 n(%)	2 n(%)	3 n(%)	4 n(%)
excellent	56	7 (12.5)	33 (58.93)	15 (26.79)	1 (1.79)	0
good	18	1 (5.56)	5 (27.78)	9 (50)	3 (16.67)	0
moderate	16	0	6 (37.5)	9 (56.25)	1 (6.25)	0
weak	26	0	3 (11.54)	9 (34.62)	11 (42.31)	3 (11.54)
surgery treated	6	0	0	2 (33.33)	2 (33.33)	2 (33.33)

study showed that body mass index (BMI) is not a predictor of success, although the limited number of subjects should be taken into consideration. Several studies confirm that prolonged symptoms adversely affect the outcome. [25, 26]. Subjects' results were better when the duration of pain was shorter than three months compared to subjects who had symptoms with duration of pain longer than three months. In the study by Kaufmann et al. [27], there was good response in 62.4% (56.5, 68.3%) for VAS under three months and 40.6% (37.2, 44.0%) more than three months, in the study by Ghahreman et al. [28], 47% (25-69%) for subjects under three months and 55% (22.88%) with pain more than three months correlated with our results, which were 82.9% for subjects with pain up to three months and 44.5% with pain more than three months.Several studies suggest that the duration of symptoms before the procedure is the best predictive factor for the success of the intervention.This has already been observed by Ng et al., who recorded a significant reduction in VAS at the three-month follow-up of patients with chronic symptoms [29]. In a very small group of 25 patients with disc herniation, Vad et al. [30] noted the reduced effect in the patients with prolonged pain of over one year.In a group of 69 patients with disc herniation, Lutz et al. [31] observed that the duration of symptoms for more than 24 weeks before intervention did not correspond with good post-intervention results.

In other studies, a 45% improvement of pain duration and a 25% improvement in chronic patientswere found. This was due to the chronic compressive effect, which causes ischemic changes, oedema and demyelination of the nerve root [32, 33]. These irreversible neurological alterations result ingreater vulnerability and resistance to the effects of corticosteroids [34]. The level of nerve root compression that was analysedby MRI was associated with the pain level. Thus, the lower the nerve root compression, the better treatment response; this was also confirmed by the other study [35, 36, 37]. In fact, the PRT used in this study demonstrated successful pain reduction at low-level nerve root compression, while also confirming the anti-inflammatory effect of corticosteroids.

In patients with significant mechanical compression of the nerve roots, the effect of the transforaminal epidural applications is less expected.In the study by Duygu et al. [36], 42% of the subjects showed improvement after the second week while in the study, 44% improvement was shown after the sixth month. The results indicate that after the intervention, better results can be expected in patients where the MRI shows low-level compression. In the study by Ghahreman and Bogduk [37], they concluded that the success of transforaminal epidural corticosteroid application was almost three times greater in patients with lesser nerve root compression. According to Adiley et al. [38], the comparison ofthe PRT effects in L4-L5 and L5-S1 on disc herniation showed greater efficiency in L4-L5 levels. The results are also compatible with the study by Shrestha et al. [39], where the successful treatment at the L5-S1 level was 57.14% compared to the L4-L5 level of 79.17%. Results of our study showed a percentile improvement after six months of intervention in the L4-L5 level (69.69% ± 29.7), compared to (51.52% ± 30.1) in patients with pain localisation at the L5-S1 level.This difference is probably due to the different trajectory needed to reach the level, but also the anatomical placement of the S1 root. The L4 and L5 vertebral bodies are the lowest segments of the lumbar spine. Along with intervertebral discs, facet joints, nerve radixes, and muscle apparatus, the L4-L5 segment is one of the most dynamic moving segments of the spine, providing many functions, such as supporting the upper body and allowing movement in different directions [40]. Due to its large bearing function and wide range of flexibility, the L4-L5 dynamic segment is more frequently subjected to developing pain from injury and/or degenerative lesions compared to the other lumbar segments [41]. The increased pressure on this highly exploited dynamic segment ensures the greatest mobility and pressure on the small facet joints, resulting in degeneration, facet arthritis, and instability. The high workload and pressure lead to faster degeneration of the disc, which reduces elasticity, increasing degeneration, dehydration, and herniation. Instability is associated with repetitive traumatic lesions of pars interarticularis on the left and right side, which are often a good foundation for degenerative spondylolysis and spondylolisthesis.Results obtained from many studies suggest a weaker response to epidural applications in patients who also have canal stenosis, as opposed to patients with a different type of disc herniation or a combination. [42, 43].Two weeks after the intervention, an improvement of over 50% was more frequently reported in patients with a foraminal hernia and less frequently in patients with central stenosis. After six months, patients with foraminal hernia had the most improvement,

while patients with central stenosis rarely had an improvement of 50% or greater. A good response to treatment in lateral hernias, as opposed to central stenosis, was reached in the study by Choi et al, and by Komori et al. [44, 45]. Central canal stenosis is most often associated with prolonged clinical symptomatology resulting in irreversible changes leading to designated chronic inflammation, which has a major impact on the reparative processes after treatment with minimally invasive techniques, which may result in reduced reaction and susceptibility of the nerve root to medicine application [46].Many studies mention a poor response to transforaminal applications in patients with disc herniation in combination with central canal stenosis[47].

CONCLUSION

The results of this study confirmed that PRT is an effective method for patients with lumbar pain and radiculopathy. After the treatment, the benefit was greatest in patients who experienced symptoms for a short time before the intervention. It is preferable for PRT to be done as soon as possible after the onset of symptoms. Patients who experienced the greatest benefits from PRT are those with lateral herniationand less nerve root compression.

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Резиме

КЛИНИЧКА ЕФИКАСНОСТ КАЈ ЛУМБАРНА ПЕРИРАДИКУЛАРНА ТЕРАПИЈА КАЈ ПАЦИЕНТИ СО СКИЈАТИКА

Димитар Велјановски[1], Сандра Дејанова Панев[1], Маша Костова[1], Даниела Ристиќ-Стомнарска[2], Татјана Делева Стошевска[2], Петар Јаневски[3], Смиљана Бундовска Коцев[3], Билјана Пргова[1]

[1] Оддел за радиологија, Градска општа болница „8 Септември“ Скопје, РС Македонија
[2] Оддел за неврологија, Градска општа болница „8 Септември“ Скопје, РС Македонија
[3] Оддел за радиологија, Универзитетска клиника „Мајка Тереза“, Скопје, РС Македонија

Перирадикуларна терапија (ПРТ) е минимално инвазивна радиолошка процедура, која се користи кај пациентите со хронична болка во лумбалниот ‘рбет. Целта на студијата е да се идентификува успешноста на третманот кај пациентите со скијатика преку клиничките и радиолошките варијабли.

Студијата е проспективна и во неа беа вклучени 166 пациенти третирани со ПРТ. Интензитетот на болката се дефинира преку VAS-скала и нивото на подобрување се презентира како одлично (преку 75 %), добро (50–70 %) средно (25–49 %) и слабо (помалку од 25 %). Пèциентите беа иследувани на 2 недели, 3 и 6 месеци по интервенцијата.

По 2 недели, сè до 3 месеци од интервенцијата, вкупно н = 32 (58,18 %) пациенти беа со одлично подобрување, додека по 3 месеци одлично подобрување имаше кај н = 41 пациент (74,55 %), по 6 месеци одлично подобрување кај н = 41 пациент (74,55 %) во однос на оние пациенти со болка подолга од 1 година.

Процентот на подобрување 6 месеци по интервенција беше најголем кај пациентите без компресија на нервниот корен (86,25 ± 19,2), најголемо подобрување имаше кај пациентите со локализирана болка на ниво на Л4/Л5 (69,69 ± 29,7), најдобар резултат по 6 месеци имаше кај пациентите со екстрафораминарна хернија, во однос на пациентите со централна стеноза (40,21 ± 30,7). Нашите резултати од студијата сугерираат подобри резултати пост ПРТ-интервенција кај пациентите со скијатика во зависност од пократкото времетраење на болката, отсуство на компресија на нервниот корен, нивото на ив-просторот, како и од типот на хернијација.

Клучни зборови: епидурален простор, радикулопатија, болка, МРИ, стероиди