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Efficacy of Combined Dorsal Root Ganglion Pulsed Radiofrequency and Cervical Epidural Steroid Injection on Radicular Neck Pain

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ABSTRACT

AIM: To evaluate the efficacy and safety of combined transforaminal anterior epidural steroid injection (TAESI) and dorsal root ganglion pulsed radiofrequency (DRG-PRF) therapy on the radicular neck pain.

MATERIAL and METHODS: The results of 84 patients with cervical radicular pain who underwent combined DRG-PRF and TAESI under fluoroscopy were evaluated retrospectively. Primer outcome is the pain measurements of the patients before and after the procedure at the 1st, 3rd, and 6th months were evaluated with the Verbal Pain Scale (VPS). Our secondary outcome was the evaluation of patient satisfaction in the 1st, 3rd, and 6th months after the interventional treatment, and it was considered significant if it was evaluated as "good" above 50%.

RESULTS: We found statistically significant decrease in the pain scores of the patients in the 1st, 3rd, and 6th months compared to the pre-intervention (VPS 0) ($p<0.001$). After the procedure, the patients expressed their satisfaction level as 69.1% at the 1st month, 71.5% at the 3rd month, and 72.6% at the 6th month as "very good/good". While the operation was mostly performed at the C5-6 level on both sides, it was seen that 61.9% of the operations were applied from the right side and 38.1% from the left side. No adverse effects or fatal neurological complications were observed.

CONCLUSION: Although the efficacy and complications of cervical TAESI and DRG-PRF treatment are controversial in the literature, we think that this combined treatment can provide effective pain palliation in experienced hands with appropriate patient selection, considering the risk / benefit ratio.

KEYWORDS: Radicular pain, Chronic pain, Pulse radiofrequency, Cervical epidural injection, Dorsal root ganglion

INTRODUCTION

Cervical radiculopathy results from inflammation of the cervical spinal roots and may include pain, paresthesia, numbness, and muscle weakness along the spinal nerve. It is common in the community, and its frequency was found to be 83.2 per 100,000 (9).

Cervical radicular pain is an important health problem that affects the quality of life and functionality of patients. Disc herniation and age-related cervical spondylosis are the most common causes of cervical radiculopathy. C 5-6, C 6-7, and C 7-8 nerve roots are most frequently affected, respectively (4). Herniated disc material presses on the cervical nerve roots, and the pain radiates along the nerve pathway in the shoulder, arm, and fingertips. In the treatment of cervical radicular neck pain due to disc herniation, conservative treatments (oral drug treatments, exercise, lifestyle changes, etc.), interventional and surgical treatment methods are applied multidisciplinary (9).

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Dorsal root ganglion (DRG) pulse radiofrequency (PRF) application combined with cervical epidural steroid injection is one of the preferred and effective treatment methods in patients who do not respond to conservative treatment.

The efficacy of transforaminal anterior epidural steroid injection (TAESI) in neck pain has been examined in many different studies in the literature, and it has been shown that selective transforaminal epidural steroid and local anesthetic injection reduces pain and improves function in 40-84% of patients with cervical radiculopathy (18). Epidural steroid injections have pronounced effects in the treatment of radicular pain from cervical disc disease, and this treatment has been effective for more than six months (3). In addition, it is a common and effective method for postlaminectomy syndrome in patients who underwent surgery for spinal stenosis. However, 20 to 40 percent of steroid-treated patients do not experience a satisfactory reduction in pain, and therefore other therapeutic approaches are needed (3).

Another non-surgical approach is DRG-PRF treatment. Short-term and intermittent RF signals in PRF application are applied to the neural tissue from a radiofrequency (RF) generator (19). These two procedures are usually done separately, and only short-term pain relief is provided with either procedure. A combination of these two therapies can be used to achieve better clinical results. Combination therapy is assumed to be safer and more effective in reducing chronic pain. In our study, we evaluated the effectiveness of this combined TAESI and PRF.

MATERIAL and METHODS

This study was carried out retrospectively in Adnan Menderes University Faculty of Medicine, Department of Anesthesiology and Reanimation, Algology Department, after the approval of Adnan Menderes University Faculty of Medicine Ethics Committee. In our study, 90 patients who underwent combined TAESI and DRG-PRF for neck and arm pain between 01.10.2018 and 31.03.2019 were evaluated retrospectively. The cases consisted of patients who applied to our outpatient clinic due to neck and arm pain, who received medical treatment and/or physical therapy, but whose complaints did not regress. Patients with neurologic deficits requiring surgery, known allergies to lidocaine and dexamethasone, recent head and neck surgery, diabetic patients with impaired blood sugar regulation, epidural steroid injections or depot steroids in the last 15 days, patients with progressive neurological deficits, coagulation disorders (INR>1.5; platelet <100.000/mm^3), those with any lesion or infection in the cervical region that would prevent epidural intervention, and pregnant women were not treated. Patients who had missing information in their files and could not be reached by calling were excluded from the study.

Protocol

After the interventional procedures performed in the algology outpatient clinic, the patients come for the control at certain intervals, the first of which is 15 days later, to organize their treatment and evaluate the procedure's result. Demographic data of the patients, pain assessment forms, Verbal Pain Scale (VPS) values before and after the intervention and when they came to the control, satisfaction levels, history of the intervention, duration of symptoms, the side and level of the procedure performed, the history of the previous operation, the presence of complication (vein leakage, dizziness, intrathecal spread, nausea, radicular spread, etc.) data are recorded. The data of our study were obtained retrospectively from the files.

Interventional Procedure

In the routine practice in our clinic, the bleeding profile of the patients is checked before the procedure. Fasting for 4-8 hours is required on the day of the procedure. Vascular access is opened before the procedure. Midazolam 0.02mg/kg and Fentanyl 1mcg/kg are administered intravenously for sedation.

Interventional treatment is performed in the supine position under sterile conditions in the operating room, accompanied by a C-arm fluoroscopy device. The first visible intervertebral foramen under fluoroscopy is C2-C3. Once the appropriate cervical spacing has been determined, the C-arm fluoroscopy device is oriented obliquely at 45 to 65 degrees until the cervical neural foramina are visualized as a circle. The cannula insertion site is determined. The skin or subcutaneous tissue is anesthetized with 2% lidocaine. A 5 cm long 5 mm active-tipped RF cannula is advanced towards the 6 o'clock position of the neural foramina. Advance the needle until the upper facet joint is in contact, then guide the needle into the foramen. After entering the foramen, the needle is advanced up to the facet column, and the epidural space is entered while taking an anterior-posterior view with the scope to avoid direct damage to the intrathecal or spinal cord. The catheter needle is considered to be placed near the dorsal root ganglion when abnormal sensation, vibration, or pain is observed with less than 0.7 Volt stimulation for sensory stimulation and when pulses are taken in the arm with less than 2.0 Volts stimulation for motor stimulation. Approximately 0.5 mL of non-ionized contrast medium is given to confirm the needle placement. The spread of the radiopaque substance both in the foramen and around the nerve root by holding the periradicular membrane is observed in the scope. Afterwards, 4 mg (1 ml) dexamethasone and 20 mg (1 ml) lidocaine is applied. The radiofrequency generator is adjusted so that the temperature of the catheter needle tip does not exceed 42ºC and is subjected to pulsed radiofrequency treatment for 4 minutes.

Statistical Method

Research data were evaluated using SPSS 21.0 statistical program. Conformity of continuous variables to normal distribution was investigated using visual (histogram and probability graphs) and analytical methods (Kolmogorov-Smirnov/Shapiro-Wilk tests). For the descriptive statistics of the research, the mean and standard deviation in data with normal distribution, median, minimum and maximum in data that do not comply with normal distribution are shown. The Chi-square test was used to show whether there is a difference between categorical variables in the study. Student's t-test and One Way ANOVA Analysis of Variance Test were used

to compare continuous variables with parametric properties in independent groups, Mann-Whitney U test and Kruskal-Wallis Analysis of Variance Test were used to compare continuous variables that did not have parametric properties in independent groups. For statistical significance, the p-value was determined to be less than 0.05.

RESULTS

The interventional procedure was applied to 90 patients, but 84 patients were included in the study because the data of 6 patients could not be accessed. Combined DRG + TAESI treatment was applied to all of these patients. Of the 84 patients who participated in the study, 66.7% were female, and 33.3% were male. The mean age of the patients participating in the study was 54.5 ± 11.78 years. The procedure was performed on the right side in 52 patients and on the left side in 32 patients. On both sides, the operation was mostly carried out at the C5-6 level; when the levels were evaluated separately as right and left, 48.1% (n=25) for the right side and 43.8% (n=14) for the left side were performed from the C5-6 level (Table I).

While the mean VPS score was 8.06 ± 1.76 before the procedure, it was 4.14 ± 2.23 at the 1st month, 3.83 ± 2.23 at the 3rd month, and 3.70 ± 2.30 at the 6th month after the procedure was found, and statistically, a significant difference was found ($p<0.05$).

They expressed the degree of patient satisfaction after the procedure as 69.1% at the 1st month, 71.5% at the 3rd month, and 72.6% at the 6th month as "very good/good" (Table II).

The most common complication after the procedure was venous leakage ($p>0.05$). No fatal complication was observed in any of the patients (Table III).

DISCUSSION

Cervical TAESI, application of local anesthetic and steroid mixture DRG-PRF at the level of the affected nerve root, is used in the treatment of cervical radicular pain. In the evaluation of patients who underwent combined TAESI – DRG-RF, a statistically significant decrease was found in the pain levels and satisfaction of the patients compared to the pre-intervention (VPS 0) ($p<0.001$). It was observed that more than 65% of the patients evaluated their satisfaction level after the procedure as good or very good. It was observed that 61.9% of the procedures were applied from the right side and 38.1% from the left side. Operations for both parties were mostly carried out at the C5-6 level. No serious complications were observed in the post-procedure evaluation of the patients.

Epidural steroid injection is made at the level of the root closest to the painful dermatome. In addition to its short-

Table I: Distribution of the Sides According to the Level of the Neural Foramen Applied to the Intervention

Cervical Vertebra Level	Side		p
	Right n (%)	Left n (%)	
C 4-5	3 (5.8)	4 (12.5)	0.423
C 5-6	25 (48.1)	14 (43.8)	
C 6-7	3 (5.8)	6 (18.8)	
C 3-4, C 4-5	1 (1.9)	1 (3.1)	
C 3-4, C 5-6	1 (1.9)	0 (0.0)	
C 4-5, C 5-6	7 (13.5)	3 (9.4)	
C 4-5, C 6-7	2 (3.8)	0 (0.0)	
C 5-6, C 6-7	10 (19.2)	4 (12.5)	

Table II: The Patients' Satisfaction Levels According to Months

Patient Satisfaction	n (%)
Postprocedural 1st-Month	
Very Bad	3 (3.6)
Bad	23 (27.3)
Good	34 (40.5)
Very Good	24 (28.6)
Postprocedural 3rd-Month	
Very Bad	2 (2.4)
Bad	22 (26.1)
Good	35 (41.7)
Very Good	25 (29.8)
Postprocedural 6th-Month	
Very Bad	2 (2.4)
Bad	21 (25.0)
Good	38 (45.2)
Very Good	23 (27.4)

Table III: Complications

	n (%)
No Complication	67 (79.8)
Nausea	2 (2.4)
Accidental Intravenous Injection	9 (10.7)
Subdural Spread	3 (3.6)
Accidental Intravenous Injection + Dizziness	1 (1.2)
Accidental Intravenous Injection + Subdural Spread	1 (1.2)
Accidental Intravenous Injection + Subdural Spread + Dizziness	1 (1.2)

term effect, it has been shown to be effective in 6-month and 1-year long-term follow-ups (8,20,21). In studies, it has been reported that there is a significant improvement in patients who were accepted as candidates for surgery and who received interlaminar or transforaminal cervical epidural steroid injection due to cervical radicular pain lasting longer than one month (1), and that surgery was not required in more than 80% of patients who were thought to need surgical intervention (5). There are two basic approaches for cervical epidural injections: the interlaminar approach and the transforaminal approach (9).

Although the complication rate is higher, the transforaminal approach provides higher efficiency with less volume (12,13,15,22). In our clinic, the transforaminal approach is preferred. Although the efficacy of steroids in the palliation of pain in cervical epidural injections is supported by studies, various catastrophic complications such as spinal cord or brain stem infarction and related paraplegia and death lead to debates about this intervention (6,14). However, the incidence of complications is unclear, and all reported cases with irreversible, permanent damage appear to be in procedures with particulate steroids. Animal studies also support this (17). Dexamethasone sodium phosphate, a particle-free steroid, is routinely used in our clinic. No neurological complications were observed in any of the patients.

Another method, pulsed radiofrequency therapy, is increasingly used today. In this method, a current of 20 milliseconds each is applied twice a second from the electrode tip for 240 seconds, and the temperature does not exceed 42°C. The effect originates from the electromagnetic current generated at the electrode tip and is effective in the treatment of neuropathic pain. DRG-PRF application is an additional treatment recommended in cases that do not respond to epidural steroid application (22). In a study examining the treatment effects of pulsed radiofrequency techniques in patients with radicular pain, it was stated that 53% of patients with cervical radicular pain had more than 50% reduction in pain one week after treatment, and 55% of had more than 50% reduction in pain three months after treatment (2). PRF administration has a great effect on cervical radicular pain that does not respond to other conservative treatments, including oral medications, physical therapy, or epidural steroid injection, but may produce transient neuritis and a burning sensation in the treated spinal nerve, a slight loss of muscle strength in the hand or arm on the treated side, as an adverse outcome (11,24).

Maintaining a temperature of 42°C at the electrode's tip allows heat to dissipate, prevents the risk of thermal damage complication and thus reduces post-procedure adverse effects (7,23). We did not encounter any complications of PRF in our study.

In addition to studies showing that combined treatment at the same time is successful, there are studies in the literature advising the addition of DRG-RF in the treatment of cervical radicular pain in patients who do not respond to TAESI application. O'Gara et al. applied TAESI and DRG RF to 59 patients in a 1-year follow-up study after the procedure (16). At C4-C5-C6 levels, they attempted approximately the same rate. They claimed that they observed a clinically significant reduction in 67% of patients with chronic cervical radicular pain. Koh et al. reported that the combined application of PRF and TAESI in patients with chronic refractory radicular pain provided higher treatment efficacy than TAESI alone (10). In our study, we also found a significant decrease in pain scores and an increase in patient satisfaction after combined treatment compared to before the procedure.

The limitations of our study are its retrospective nature and the absence of a control group. Furthermore, because the complication rate for cervical epidural injections is low, the sample size is insufficient to assess the procedure's safety.

Although the effectiveness and complications of TAESI and DRG-PRF treatment are controversial in the literature, considering the contribution of this treatment to the pain palliation of the patients and the risk / benefit ratio, we think that this combined treatment in experienced and competent centers with appropriate imaging methods can provide effective and uncomplicated pain palliation. To investigate the efficacy and safety of these therapies, future randomized and placebo-controlled studies are needed.

AUTHORSHIP CONTRIBUTION

Study conception and design: AK, SS, ONA

Data collection: AK, EE, ONA

Analysis and interpretation of results: AK, SS, EE, ONA

Draft manuscript preparation: AK, SS, EE, ONA

Critical revision of the article: AK, SS, EE, ONA

Other (study supervision, fundings, materials, etc...): AK, SS, EE, ONA

All authors (AK, SS, EE, ONA) reviewed the results and approved the final version of the manuscript.

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