Effects of perineural steroid injections on median nerve conduction during the carpal tunnel release

Delovanje perineuralne primene kortikosteroidnih injekcija na sprovodljivost medijalnog nerva tokom oslobađanja karpalnog tunela

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Abstract

Background/Aim. The treatment outcome of the median nerve compressive neuropathy in the carpal zone due to carpal tunnel syndrome (CTS) is represented by recovering the nerves sensibility, conductivity, condition and strength. Perineural application of betamethasone during the surgical decompensation might result in faster recovery of compressed median nerve’s conduction speed. Methods. In this study 40 patients with CTS were randomly divided in the two groups. In the first group (n = 20) we performed the surgical decompensation of the median nerve by the open release of the carpal tunnel, and in the second group (n = 20) we applied a perineural injection of 1 ml of betamethasone immediately after the surgical decompensation. We performed the electrodiagnostic (ED) examinations 7, 30 and 90 days after the surgery, and measured the conduction speed of the median nerve in the carpal tunnel zone and the sensitivity conduction speed of the median nerve. Results. Significant differences in examined ED respective variables values in different time intervals were obtained. At the final measurements, 90 days after the surgical procedure, both groups evidenced a full regaining of conduction speed of the median nerve.

Key words: carpal tunnel syndrome; reconstructive surgical procedures; intraoperative period; betamethasone; injections; median nerve; electrodiagnosis.

Introduction

In the past two decades a number of scientific studies were performed helping to understand the causes and process of developing the carpal tunnel syndrome (CTS), clinical forms of the disorder, and ways of treatment of the median nerve compressive neuropathy in the carpal zone. Nonsurgical treatments, especially the corticosteroid injections, have given good results initially. Steroid injections provide calming of an inflammatory process and help to reduce swelling.
of the compressed nerve, thus, the therapy results in loss of symptoms and in recovery of electrodiagnostic (ED) parameters. In the early stages of the disease the outcome of the nonsurgical treatment is satisfactory. Long term assessment of patients with carpal tunnel syndrome (CTS) registered a number of recidives, so that the common standing point of contemporary medicine is that for the majority of CTS cases the only successful treatment is a surgical one. The later refers particularly on the mild and severe forms of the disorder, whereas the conservative treatment is reserved for the low severity compression neuropathy cases and for the patients who lack the motivation for the surgical intervention. The treatment today is aimed not only to resolve the symptoms of the disease, but to find a way to the fastest and best restitution of whole hand and compressed nerve functions.

Many physicians use their own protocol of examinations and clinical tests to make diagnosis. Some authors disclaim the necessity of electrophysiologic examinations, while others consider them as extraordinary important. During the history taking and physical examinations of the patients, it is not enough just to make the CTS diagnose, but it is necessary to estimate the stadium of the disorder, i.e. the severity of the compressive neuropathy.

Therefore, the treatment outcome of the median nerves compressive neuropathy in the carpal zone might differ considerably, depending on time of making an exact diagnosis of the disease, and on the choice of the treatment method. The outcome may be interpreted as subjective and objective one. Objective results of recovering the nerves sensibility, conductivity, condition and strength are those got from clinical and ED testing. The achieved recovery of the diseased hand is usually evaluated through data obtained by the functional tests, ED examinations, present complications, and a time needed to return to work. Subjective results given by the patient himself, such as disappearing of symptoms and relief, usually are not referred in the outcome report of the treatment.

Phalen’s conclusion in his report was that the relief of the symptoms produced by the steroid injections confirms the CTS diagnosis. Katz et al. give in their studies the detailed description of positive effects provided by the steroid injections into the carpal tunnel. There are a lot of studies comparing the outcomes of steroid injection treatments with those obtained by surgical decompression. There is no doubt that a surgical treatment results in better and long-term outcomes. Although the surgical treatment usually is not followed by high risks, and is a common surgical procedure, it involves some discomfort, thus it is a common practice to proceed the surgery by a conservative treatment, having considered the severity of the compressive neuropathy. Edgell et al. confirmed their hypothesis that the surgical treatment preceded by the steroid injections, resulted in better outcome.

Considering good, but short-term effects of the steroid injections, we supposed that the application of the steroid injection during the surgical procedure, might provide faster regain of compressed nerves conduction speed, and, consequently, faster recovery of the median nerve. The research on the outcomes of the intrasurgical application of steroid injection has been performed with great caution, considering that, to our best knowledge, none of the surgical methods up to now gave significantly better outcome than the others.

**Methods**

The study was performed on a group of 40 patients with clinically obvious CTS, treated at the Clinic for Plastic Surgery and Burns, Military Medical Academy in Belgrade, 2005 and 2006.

According to the up-to-date knowledge, recovery of the sensitive and motion functions in majority of surgically treated patients is obvious, but can take weeks or months. Aiming to shorten this time as much as possible, we decided to apply 1 ml of betamethasone during the surgery, immediately after the decompression. For the evaluation of the applied treatment method, we used objective results of measurements concerning the recovery of median nerve sensibility and conductivity, performed with parameters of ED examinations. There were examinations of the combined median nerve conductive speed in the carpal tunnel zone, and sensitive conduction speed.

We divided the patients in the two groups. In the first group we performed the surgical decompression of the median nerve by the open release of the carpal tunnel, and in the second group we applied a perineural injection of 1 ml of betamethasone immediately after the surgical decompression.

Aches, "pins and needles", stiffness and limited motion of the diseased hands were registered in all patients before the treatment. The following provocative tests were performed in each patient: Phalen’s test, Tinel’s test and Durkan’s test for median nerve compression.

Together with clinical tests, the neurophysiologic examination of characteristics of the median nerve (EMNG) was performed in all the examinees. Measurements of the combined median nerve conduction speed in the carpal tunnel zone, and of the sensitive speed of median nerve conduction, were evaluated.

To avoid problems of statistical nonindependence in the analysis, only one operation from each patient was used, even from those who had CTS on both hands.

After the presurgical treatment and preparation, each patient was operated on either in regional intravenous, or in axillary block anesthesia using the tourniquet. The same surgery technique of the open carpal tunnel release for decompressing the nerve was performed in each patient.

The incision was set in the projected axis of the fourth finger, beginning at the middle part of the palm, following the proximal part between the thenar eminences, till the proximal wrist crease. After the incision of the skin and subcutaneous tissue was made, deep structures were identified by a careful dissection. Eye-controlled directly, the transversal carpal ligament was cut, to proceed to the release of the median nerve from its surrounding structures. In the cases where the surrounding tissue was thickened, it was extirpated. The epineurectomy was not performed, since a plenty of studies have shown that the procedure did not bring any difference in better recovering of the com-

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pressed nerve. In the course of the nerve preparation, mandatorily the motion branch was identified and released. After the thorough hemostasis, the wound was sutured in one layer. In 20 patients, after the decompression of the nerve, and after the partial suture of the surgical wound, 1 ml betamethasone was injected perineurally through a plastic catheter. After the application of the corticosteroid, the plastic catheter was pulled out and wound suture completed. In all patients, hands were bandaged up without a splint. The patients were told that they could start to slightly move their fingers right after the operation.

In all the patients, a controlled physical therapy started up on the first postoperative day. Daily, after removing the bandages, a therapy with “Bioptron” lamp was performed, together with the laser therapy. A laser tube of 820 nm and a 1000 Hz frequency was used. After the physical therapy, hands were again bandaged up, until the next day therapy. On the tenth day after the surgical operation, kinesitherapy and electrophoresis started up, with the application of potassium iodide and novocain. Equal physical therapy during twenty days was applied in all patients.

Seven, thirty and ninety days after the treatment, neurophysiologic examinations of median nerve were repeated in examinees, performed by the same examiner and with use of the same equipment, always followed by the analysis of the characteristics of the treated nerve. Clinical tests were repeated as well, and it was registered either presence or absence of symptoms that were noticed before the treatment.

The outcome of the applied treatment method was assessed by the patient’s subjective feelings, provocative clinical tests, and results of ED examinations.

### Results

Of 40 patients, 27 (67.5%) were women and 13 (32.5%) were men. Their age ranged from 29 to 80 years with a mean of 51.6 years.

In examined patients, a disappearing of before-surgery symptoms after treatments applied was prominent as seen in the table 1. In three quarters of patients, we registered that all symptoms had been present before the surgery dissapeared within only seven days after the surgical procedure. Disappearing of symptoms was almost equal in both groups of patients, and final measurements showed that in only two patients of the first group and in one of the second group, presence of some previous symptoms was registered (Table 1).

#### Table 1

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<th>Treatment method</th>
<th>Days after surgery</th>
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<td>7</td>
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<tr>
<td>Surgery</td>
<td>75%</td>
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<td>Surgery and betamethason intraoperatively</td>
<td>77.5%</td>
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*Note: the results are given as percentage of patients without the symptoms*

Mean values of the combined median nerve conduction speed (CS) in the carpal tunnel zone, measured before the surgical treatment, were almost identical in both first and second group of patients (CS1 = 25.487 msec, and CS2 = 25.387 msec, respectively). The values largely overlap the reference values of 45 msec. First measurements, performed seven days after the surgical operation, did not show a significant recovery of the conduction speed in neither group of patients, although a slight recovery, attending the respective values of CS1 = 27.407 msec and CS2 = 29.420 msec, were registered. Measurements performed in the second term, after one month, showed that in both groups there were enhanced improvements of the conduction speed, particularly in the second group where 1 ml of betamethasone was given to each patient in the course of the surgical operation, although in neither group the reference values were attended yet. In the second group of the patients statistically significant better recovery of the nerve function was achieved ($t = -2.365$; $p = 0.025$). At the final measurements, 90 days after the surgical operation, both groups evidenced a full recovery of the conduction speed in the carpal tunnel with statistically significant better results in the second group of the patients ($t = -2.116$; $p = 0.043$). On the other words, statistically significant faster and better recovery of the conduction speed in the carpal tunnel was achieved in the patients treated with the application of betamethasone during the surgical procedure (Table 2).

#### Table 2

<table>
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<th>Pre- and postoperative values of the median nerve conduction speed</th>
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<td>Treatment method</td>
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<td>Surgery</td>
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<td>Surgery and beclomethasone intraoperatively</td>
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*p < 0.05 vs surgery treatment*

Similar results were obtained in the examinations of the sensitive conduction speed recovery of the median nerve. During the initial measurements, before the beginning of the treatment, almost identical values of the sensitive conduction speed (SCS) were registered in both groups of the patients (SCS1 = 32.200 msec and SCS2 = 31.493 msec). The measurements performed at the 30th postoperative day, revealed statistically much better recovery in the group of the patients treated with betamethasone applied intraoperatively ($t = -2.516; p = 0.018$). In patients of the second group almost full recovery of the sensitive conduction speed was achieved already after 30 days (mean value SCS2 = 43.133 msec). Mean values at the final measurements did not show a statistically important difference between treatment methods applied (SCS1 = 45.347 msec in the first group and SCS2 = 47.673 msec in the second group of the patients).

Discussion

The aims of CTS treatment today are not the same as used to be decades ago. In fact the only aim of treatment before was to achieve vanishing of compressive neuropathy symptoms, a subjective good feeling and satisfaction of the patients. Today, the aim of the treatment is not only to resolve the present symptoms, but to find a way of the best and the fastest restitution of all hand functions, and those of the compressed nerves.

The initial therapy for the majority of CTS patients is nonsurgical one\(^4,\,14,\,18\). In 1966 Phalen\(^13\) thought that the majority of CTS patients should not undergo surgical treatment. Surgeons who treat hand diseases, often start a treatment with practicing one of nonsurgical methods during a few weeks, and make a decision afterwards whether to go for a surgical treatment\(^17\).

Investigations done by Katz and Simmons\(^14\), showed that the improvement regarding the before-surgery symptoms like pain and numbness tend to go much more quickly than the recovery of the motion and sensitive symptoms. The same authors reported the fact that locally applied corticosteroid injections provided faster recovery of the median nerve conduction.

According to the up-to-date knowledge, a preoperative application of corticosteroids results in a better surgery outcomes of the CTS. In the patients who, in the course of their nonsurgical treatment, have been treated with corticosteroid injection, a temporary improvement and relieving of symptoms, as well as far better surgery outcomes are achieved. Marshall et al.\(^18\) reported better surgery outcome in 94% of patients treated with corticosteroids before surgery with registered temporary relieving of symptoms.

There is no doubt that a surgical treatment is far more efficient way to resolve the CTS, than a conservative one. Wishing to make a surgical treatment more efficient by using positive outcome of the steroid injection in the treatment of the CTS, we examined the possible effects of the steroids on the time needed for the recovery of the median nerve conduction, in the surgically treated CTS patients.

We were surprised with the results at the measurements of the median nerve conduction speed in the carpal tunnel. Significantly better results were reached in the patients treated with betamethasone.

Examination of a recovery of the sensitive conduction speed showed as well, that the degree of recovery was far higher in the second group of patients, and the obtained difference in the values was statistically significant after thirty days, while the values obtained at the final measurements, ninety days after, were almost identical. Consequently, the injected betamethasone did not produce better, but faster recovery.

The obtained results demonstrate, without doubt, the positive effects of injecting steroids within the surgical decompression. It ought to be pointed out that a full recovery of the compressed nerve conduction was achieved in both groups of the patients. However, in both examined variables at different time intervals, we got, to a certain point faster and better recovery of the examined ED parameters in the second group of the patients were given 1 ml of betamethasone within the surgical procedure.

Conclusion

The results obtained showed that intraoperative application of the steroid injection during the surgical decompression resulted in faster regaining of the median nerve conduction speed.

REFERENCES


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