International Research Journal of Pharmacy and Medical Sciences
ISSN (Online): 2581-3277

Effect Observation between Surgical and Pharmaceutical Management of Carpal Tunnel Syndrome

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Abstract—
Background*: There is no global approval on the efficiency and safety of different modalities for carpal tunnel syndrome management. Various minimally invasive methods were suggested to reduce morbidity. Nevertheless, the risk of neurovascular insult and failure still exist.*
Aim*: To observe the outcome effect of carpal tunnel syndrome managed with mini-open limited incision release of the transverse carpal ligament and the outcome of carpal tunnel syndrome managed with local injection of Methyl prednisolone in the carpal tunnel.*
Methods*: Our prospective, randomized and double blind investigation included 126 patients, of both sexes, aged 26-67 years and diagnosed of unilateral idiopathic carpal tunnel syndrome using clinical (objective and subjective) and electrophysiological study (a non-recordable distal sensory latency of the median nerve) at Prince Hashim military hospital, Zarqa, JORDAN, during the period Feb 2014-Nov 2017. Patients in group S (n= 62,median age of 57 yr) were scheduled to open longitudinal mini-limited incision (2 cm) in line with the fourth ray, extending to but not crossing the distal wrist crease with release and dividing the transverse carpal ligament. Patients in group M (n= 64, median age of 41 yr) were scheduled to local injection of methyl prednisolone 40 mg in the carpal tunnel. The needle of the syringe is placed at the anterior wrist flexion crease at a 30-degree angle and slowly advanced until the tip is just beyond the tendon of the palmaris longus. Patient-symptom intensity and functional status outcomes were evaluated using Boston Carpal Tunnel Questionnaires. Safety is measured by the need for second surgery, while efficiency is measured by the Symptom Severity Scale (SSS) (11 items) and the Functional Status Scale (FSS) (eight items) of the Boston Carpal Tunnel Syndrome Questionnaire. Failed surgery was defined if clinical features remained after surgery or there was a need for a second surgery. Outcome was stratified into full clinical feature recovery, partial or no clinical feature recovery at 12 months after local injection. All patients with history of local trauma, local steroid injection, bilateral carpal tunnel syndrome, carpal tunnel release or a diagnosis of peripheral neuropathy were ruled out. For normality, data was analyzed using the Kolmogorov–Smirnoff test. Spearman's rho correlation coefficient (r) was used for evaluating correlations between continuous parameters. All P-values less than 0.05 were considered statistically significant.*
Results*: Boston Carpal Tunnel Questionnaires in group S showed a clinical feature intensity score of 13.4 and a functional status score of 10.2. One patient in group S (1.6%) needed revision surgery after 2 years. In group M, at 1 year, only 18 (28.1%) patients had full recovery of clinical features.*
Conclusion*: The Mini-open limited incision release surgical modality was an efficient option for carpal tunnel syndrome management in recovering clinical features and regaining functionality. Local injection of Methyl prednisolone may delay surgery for carpal tunnel syndrome and it is advised to start with local corticosteroid injection when managing carpal tunnel syndrome before surgery.*

Keywords— *Open limited mini-incision; carpal tunnel syndrome; methyl prednisolone; Boston Carpal Tunnel Questionnaires*.

I. INTRODUCTION

Carpal tunnel syndrome is the most frequent of the compressive entrapment neuropathies (90%) with prevalence of 0.6% in males and 5.8% in females (1). It is caused by entrapment of the median nerve in the carpal tunnel, increasing intracarpal pressure with loss of dexterity, muscle wasting and reduced functional ability (2).Carpal tunnel syndrome can be diagnosed using clinical and electrophysiological test, but primarily is clinical.13% of electrophysiological study results are false negative and 18% are false positive (3). Clinical subjective and objective findings signs are caused by the compression of the median nerve as it travels via the tight confines of the carpal tunnel at the wrist.

Management of Carpal tunnel syndrome has different protocols such as continuous or nocturnal splinting, physical therapy, nonsteroidal anti-inflammatory drugs, injectable or oral corticosteroids and open or endoscopic release (4).Established CTS is a non-recordable distal sensory latency with an increased distal motor latency and responds weakly to conservative management, while surgical release (surgical division of the transverse carpal ligament) is the most successful management technique ,but there is no agreement that any surgical one is superior to the others. Since 1966, the size of the incision has gradually decreased, to a more limited incision (5). The short-incision open or limited-open method is the most common surgical method, permitting direct visualization of the entire transverse carpal ligament. Pain in the scar or in the palm was recorded in 82% of patients (5). Multiple minimally invasive surgical techniques reduced the morbidity after surgery and caused rapid recovery and return to work. There are complications such as the risk for neurovascular insult and partial decompression.

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The objective of our investigation was to compare outcome effect of carpal tunnel syndrome managed with mini-open incision release (2 cm) with outcome of carpal tunnel syndrome managed with local injection of Methyl prednisolone in the carpal tunnel.

II. METHODS

Our prospective, randomized and double blind investigation included 126 patients, of both sexes, aged 26-67years and diagnosed of unilateral idiopathic CTS using clinical (objective: numbness, tingling or burning pain in at least two of the three digits innervated by the median nerve; subjective: nocturnal paresthesia, pain in the median nerve distribution during activity or numbness in the median nerve distribution) and electrophysiological study (a non-recordable distal sensory latency and lengthened motor nerve latency of the median nerve). The investigation underwent at Prince Hashim military hospital, Zarqa, JORDAN, during the period Feb 2014-Nov 2017, after obtaining written informed consent from all participants and approval from the local ethical and research board review committee of RMS. All patients with history of local trauma, local steroid injection, carpal tunnel release or a diagnosis of peripheral neuropathy were ruled out.

Patients in group S (n=62, median aged of 41 yr.) were scheduled to open limited longitudinal mini-incision (2 cm) release of the transverse carpal ligament. Patient-symptom intensity and functional status outcomes were evaluated by the Boston Carpal Tunnel Questionnaires (BCTQ) (6) which were evaluated before and after surgery. Safety is measured by the need for second surgery, while efficiency is measured by the Symptom Severity Scale (SSS) (11 items) (Table I) and the Functional Status Scale (FSS) (eight items) (Table II) of the Boston Carpal Tunnel Syndrome Questionnaire (BCTQ). Failed surgery was defined if clinical features remained after surgery or there was a need for a second surgery. Surgery included a longitudinal incision not more than 2 cm in length achieved in line with the fourth ray, extending to but not crossing the distal wrist crease and the TCL was divided and released with the distal end of the forearm fascia. All patients in group M (n=64, median age of 57 yr) were administered a local injection of 40 mg of methyl prednisolone into the carpal tunnel. The patient is asked to make a fist and at the same time flex his or her wrist to aid in the identification of the palmaris longus tendon. The needle of the syringe is placed at the anterior wrist flexion crease at a 30-degree angle and slowly advanced until the tip is just beyond the tendon of the palmaris longus. If there is no persistent paresthesia, the total of 3ml of local anesthetic with 40 mg of methyl prednisolone solution is injected slowly. Outcome was stratified into full clinical feature recovery, partial or no clinical feature recovery at 12 months after local injection.

Statistics

For normality, data was analyzed using the Kolmogorov–Smirnoff test. Spearman's rho correlation coefficient (*r*) was used for evaluating correlations between continuous parameters. All P-value with 0.05 were considered statistically significant.

TABLE I. Boston carpal tunnel questionnaires (Symptom Intensity Scale).

	1	2	3	4	5
Nocturnal hand or wrist pain severity	N	Slight	Medium	Severe	Very serious
Nocturnal awakening times of hand or wrist pain during the past 2 weeks	N	1	2-3	4-5	>5
Hand or wrist pain during day time	no	Slight	Medium	Severe	Very serious
Times of hand or wrist pain during day time	N	1-2	3-5	>5	Cont.
Duration of pain during day time	N	<10 min	10-60 cont.	>60 min	Cont.
Hand numbness	N	Slight	Medium	Severe	Very serious
Hand or wrist weakness	N	Slight	Medium	Severe	Very serious
Hand tingling	N	Slight	Medium	Severe	Very serious
Nocturnal severity of numbness or tingling	N	Slight	Medium	Severe	Very serious
Nocturnal awakening times of hand numbness or tingling during the past 2 weeks	N	1	2-3	4-5	>5
Grasping difficulty of small objects	no	little	moderate	very	very

TABLE II. Boston carpal tunnel questionnaires (Functional Status Scale).

	no difficulty	**Little difficulty**	**Moderate difficulty**	**Intense difficulty**	**Cannot perform activity due to hand and wrist symptoms**
writing	1	2	3	4	5
Buttoning of clothes	1	2	3	4	5
Holding a book during reading	1	2	3	4	5
Gripping of telephone handle	1	2	3	4	5
Opening jars	1	2	3	4	5
Household chores	1	2	3	4	5
Carrying grocery basket	1	2	3	4	5
Bathing and dressing	1	2	3	4	5

III. RESULTS

In group S, there was no significant difference between patients in terms of characteristics. There were 26 males and 36 females. Table III. Patients in group S had an average BCTQ clinical feature intensity score of 13.4 (of 55) and functional status score of 10.2 (of 40), after surgery. One patient in group S (1.6%) needed revision surgery after 2 years (1 failure).Table IV.

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In group M, there were 50 females and 14 males. Of these patients: 40 were in the right hand and 24 in the left hand. Table III. Forty patients (62.5%) had full clinical feature recovery at 3 and 6 months after local injection. Table V. Only 18 patients (28.1%) demonstrated full clinical feature recovery at 12 months after injection (12 patients aged more than the median age of 41 years of 18 patients, whereas only six patients aged less than the median age of 41 years of 18 patients had full clinical feature recovery), (11 patients of the right hands and seven patients of the left hands had complete symptom relief at 12 months after injection (P>0.05)),(16 patients from females and two patients from males had full clinical feature recovery at 12 months after injection) and (12 patients in patients with clinical features period of less than 1 year before injection and six patients in patients with clinical feature period of more than 1 year had full clinical feature recovery at 12 months after injection). The other 46 patients (71.9%) at 12 months after injection were demonstrated as: 29 patients with partial clinical feature recovery, but with no need for surgery; 16 patients had surgical decompression and the remaining one patient despite complaining of clinical features, refused surgery.

TABLE III. Patient's characteristics.

	Group S	Group M
NO	62	64
Gender		
M	26	16
F	36	48
Diseased hand		
Rt.	35	40
Lt.	27	24
Median age at time of surgery (yr)	57	41

TABLE IV. Patient's outcomes. (Group S)

Boston carpal tunnel questionnaire	
Mean symptom intensity scale	13.4/55
Mean functional status scale	10.2/40
Failure	1

TABLE V. Outcome after injection. (Group M).

	Outcome
40 patients (62.5%) at 3-6 months	Full clinical features recovery
6 patients (9.4%) at 3-6 months	partial clinical features recovery
18 patients (28.1%) at 12 months	Full clinical features recovery

IV. DISCUSSION

Our study used clinical criteria and electrodiagnostic testing for diagnosis of carpal tunnel syndrome. Electrophysiological test helps for confirmation and differentiation with other causes of peripheral neuropathy. Open release of the TCL via a longitudinal incision starting at Kaplan's cardinal line distally and extending proximally beyond the distal wrist crease caused prolonged healing time and increased scar tenderness (7). More conservative operative techniques with shorter incision length are commenced (5). Surgeons recently prefer a mini-open modality (2 cm) instead of a longer incision (>4 cm) (8). The mini-open method was the most frequent used by 45.5 % of respondents compared to 33.3 % for an extensive modality (9). Management outcomes for carpal tunnel syndrome are not well demonstrated (10). The open mini incision release method in our investigation didn't cause any significant difference in patient- clinical feature intensity or functional status in the long-term after surgery. The surgical modality caused good functionality with less pain (11). Preservation of the superficial fascia and adipose tissue over the flexor retinaculum permits rapid recovery, less scar tenderness, and less pillar pain, due to preservation of the unmyelinated nervous fibers at the interthenar crease, avoiding formation of microscopic neuromas and subsequent pain after surgery. The cause of pillar pain is due to change of the carpal arch structures, edema of the tissues superficial to ligament, insult to the cutaneous branches of the palm, or relaxation of the muscles originating from the ligament. On short-term, the mini-open modality had benefits in terms of recovery time, scar sensitivity or cosmetic satisfaction.

The long term outcome of carpal tunnel syndrome local steroid injection management is variable (12). Sometimes it is effective and sometimes it is used to decrease clinical features until surgical decompression (12). Recurrence was recorded between 8 and 94% (12). A previous investigation on local corticosteroid injection in mild carpal tunnel syndrome showed that at 3 months 93.7% of the patients had good enhancement in clinical features using the Boston self-administered questionnaire (subjective) for clinical features intensity (13). Their patients experienced only mild clinical features in comparison with our patients. Another investigation found that at 3 months after injection, 94% of the wrists in the steroid injection group in comparison with 75% in the surgery group had a 20% response for nocturnal paresthesia (P<0.005). At 6 and 12 months, the percentages of responders were 85.5 and 76.3% (P>0.05) and 69.9 and 75% (P>0.05) for local steroid injection and surgical decompression, respectively (13).

They demonstrated that local steroid injection is better than surgical decompression for symptomatic relief from carpal tunnel syndrome in the short term, while at 1 year local steroid injection is as potent as surgical decompression (4).Local corticosteroid injection for carpal tunnel syndrome has more clinical enhancement in clinical features 1 month after injection in comparison with placebo (14).

Triamcinolone is a steroid with moderate action and the injectable form used acetonide has the tendency of lipid solubility; leading to a sustained longer action at the injection site. Although the recommended dose of local injection of triamcinolone for carpal tunnel syndrome is 20 mg, 15 mg triamcinolone equals 15 mg methylprednisolone (15). Injection of 40 mg of methyl prednisolone close to the carpal tunnel showed that at 1 month, 23 of 30 (77%) patients, there was an enhancement in clinical features and that after 1 year 15 (50%) there was more enhancement. A single injection with steroids close to the carpal tunnel can lead to long-term enhancement and must be addressed before surgical decompression.

Hormones have an important role in development of carpal tunnel syndrome. Local injection of steroids attains better enhancement of clinical features. Corticosteroid injection caused better recovery of clinical features. Local injection of

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steroid will bind directly to receptors within the cytoplasm of the cell. The binding of steroids to receptors leads to the inhibition of inflammatory mediator secretion via induction of lipocortin synthesis with depression of phospholipase A2, finally, inhibiting the inflammation process. Inflammatory mediators play an important role in producing clinical features in carpal tunnel syndrome. Decompression surgery was better than steroid injection for enhancement in symptomatic and neurophysiologic results in patients with carpal tunnel syndrome. Both groups of patients experienced enhancement in the total symptom score at 6 weeks. Patients in the surgery group had more enhancements in comparison with patients in the injection group at 20 weeks (16). More enhancements in electrophysiologic results were noticed after surgery. In patients with carpal tunnel syndrome, decompressive surgery attained more pain relief and nerve conduction response than 15 mg steroid injection, which is less than our dose (16).Previous Electrophysiological outcomes were similar to our results, with remarkable enhancement in the median values of the distal motor latency and distal sensory latency at the wrist (13). There was remarkable relation between the duration of symptoms before injection and the final results in other studies (17). The American Academy of Orthopedic Surgeons recommends local steroid injection when managing patients with carpal tunnel syndrome before surgery (2010) (18). Previous investigations demonstrated no statistical significant discrepancy in the final result between patients with right hand or left hand carpal tunnel syndrome. Males had no significant clinical feature relief at 1 year compared with females (P>0.05). Clinical features relief was more in patients aged more than the median age than in those aged less than the median age, but not statistically significant (P>0.05) (19).

V. CONCLUSION

Local steroid injection may delay surgery for carpal tunnel syndrome. Local steroid injection is indicated when managing patients with carpal tunnel syndrome before surgery. The mini-open limited carpal tunnel release has better outcome, is safe and efficient for carpal tunnel syndrome managing.

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