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The Effect of Addition of Buffered Dextrose 5% Solution on Pain Occurring During Local Steroid Injection for Treatment of Plantar Fasciitis: A Randomized Controlled Trial

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SUMMARY

Objective. To evaluate the potential immediate analgesic effect of addition of 5% dextrose water (D5W) during local steroid injection for treatment of plantar fasciitis (PF).

Methods. In this single blind study, 122 patients with PF were randomly assigned to receive either 40 mg triamcinolone acetonide/1ml + 0.5ml. lidocaine 2% (group A: 61 patients; 73 heels) or 40mg triamcinolone acetonide/1ml+0.5ml. lidocaine2%+ 0.5ml. buffered D5W (group B: 61 patients; 69 heels) as a local injection using the medial approach. Visual analogue scale (VAS 0-10) was used to assess the degree of pain intensity during the injection.

Results. The mean for age was 42.56 years in group A and 43.39 years in group B (P = 0.86), the female to male ratio was 2.8-1 in both groups and the mean for BMI was 31.49 in group A and 30.86 in group B (P=0.51).

A significant difference in VAS was observed; the mean was 8.26±2.00 in group A and 4.25±2.05 in group B (P <0.0001) with a confidence interval (95% CI) of 7.78 -8.74 for group A and 3.76 - 4.72 for group B.

Conclusions. The addition of 0.5 ml. D5W can decrease the pain associated with local steroid injection for treatment of PF.

KEY WORDS

dextrose; local injection; pain; plantar fasciitis

INTRODUCTION

Plantar fasciitis (PF) is a common cause of heel pain that can lead to a significant morbidity (1). It has been estimated that 10.5 per 1000 person-years among USA military personnel had PF (2). While it is a common sport injury and reported as the third most common running related health problem (3), this condition also affects older and less active people (4). According to a previous report, most people with PF were aged between 40 and 60 years with bilateral affection in 29% (5). The changed biomechanical response of the hind foot resembles the most accepted risk factor for degenerative PF (6). Although often self-limiting, PF can last for several months to years with incapacitating pain. Many interventions have been described for treatment including arch supports, strapping, heel pads, extracorporeal shock wave therapy, laser, steroid injections, topical applications and surgical interventions (7,8).

A recent review of literature recommended that PF in athletes should receive more studies to establish a specific diagnosis and treatment algorithm (9).

Local injection with corticosteroids is a commonly used method of treatment that may hasten the process of pain relief by their strong anti- inflammatory effects. They can also inhibit fibroblast proliferation and ground substance proteins which may help in the treatment of PF (10). While ultrasonogrphy may be not helpful for diagnosis of PF due to the lack of consensus about the ultrasonographic abnormalities of this condition (11) it can lead to more favorable outcome when used for guiding local injection (12).

Oral dextrose solution has long been reported to decrease pain during minimal invasive interventions as heel lance and venipuncture in infants (13) and neonates (14).

Recently, Dextrose 5% water (D5W) has been reported to decrease the pain associated with the injection of noxious

drugs as chemotherapeutics (15) and microbiospheres (16) when coadministered as the infusion solution with these agents. Its immediate analgesic effect has also been demonstrated in a randomized controlled trial of epidural D5W injection versus saline for treatment of chronic low back pain associated with radiculopathy (17). Another study reported a rapid analgesic effect of dextrose when injected as a prolotherapy for treatment of Achilles tendinopathy (18). Furthermore, Wolf et al. reported that the addition of 0.5M. mannitol (dextrose analogue) to lidocaine and epinephrine significantly improved the success of the inferior alveolar nerve block during dental procedures. The underlying mechanism was that mannitol increases the penetrability of the perineural membrane for lidocaine, and it may also directly affect nerve conduction (19).

In this study, we aimed to evaluate the potential immediate analgesic effect of D5W when locally co-administered with corticosteroid and lidocaine for treatment of PF.

PATIENTS AND METHODS

Study population

The study was carried out on one hundred and twenty two adult (>18 years) patients with chronic PF (more than three months) of those attending the out- patient clinic of the rheumatology department of our university hospital who gave an informed consent to participate after explanation of the method and potential side effects of the procedure. 8 patients were excluded from the study and one refused to participate (the flow diagram **figure 1**). PF was diag-

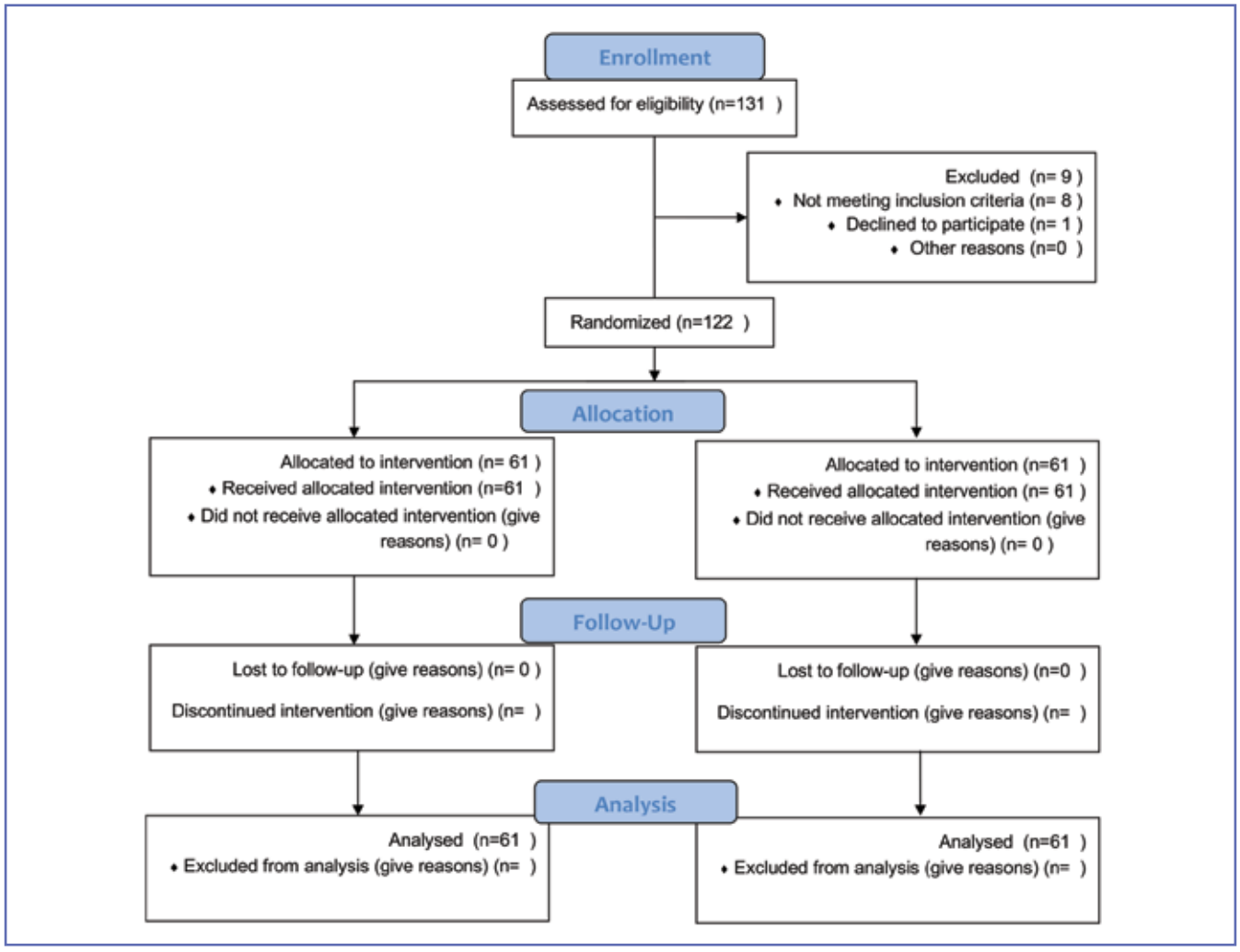

Figure 1. The flow diagram of the study participants.

nosed according to the following criteria which have been proposed by the International Statistical Classification of Diseases and Related Health Problems (ICD) category of plantarfasciitis (20):

- pain in the plantar medial heel region on palpation;
- pain most noticeably with initial steps after a period of inactivity but also worse following prolonged weight bearing;
- pain often precipitated by a recent increase in weight bearing activity.

Pregnant women and patients who previously received systemic or local steroid injection within three months or locally injected with any other material and those who had rheumatic or connective tissue diseases or Achilles tendonopathy were excluded from the study. Patients with foot pain due to arthritis, trauma or neurological problem and those with previous surgical intervention in the heel were also excluded. The trial was conducted from October 2018 to March 2019. This study was approved by the local ethical committee of our institution and it conforms with the declaration of Helsinki for human experimentations. This study meets the ethical standards of the journal (21). The trial registration number is PACTR201902720180705.

METHODS

Complete history taking and clinical examination was performed including the assessment of body mass index (BMI), disease duration and the presence of associating low back pain and/or sciatica. Plain X-ray films were performed on the affected heels in lateral view for diagnosis of the presence of calcaneal spur. At two week follow up, patients were reassessed physically or by telephone for the occurrence of any injection related complications or recurrence of heel pain. According to a computerized randomization table, the patients were randomly assigned into:

- *group A*; sixty one patients (73 heels) for receiving triamcinolone acetonide 40mg./1ml. + 0.5ml lidocaine 2%;
- *group B*; sixty one patients (69 heels) for receiving triamcinolone acetonide 40mg./1ml. + 0.5ml lidocaine 2% + 0.5ml buffered D5W. A 23 gouge 1.4 inches needle was used for injection.

Through a single blind technique, the affected heel was completely sterilized and then slowly injected using the medial approach into the most tender point while the patient is in supine position. The patients were then advised not to do any long standing or walking activity for two days. The visual analogue scale (VAS) from 0 to 10 was used to evaluate the degree of pain during local injection where 0 resembles the least pain and 10 resembles the strongest degree of pain felt by the patient.

DATA ANALYSIS

Statistical analyses were performed using SPSS Ver. 21.0 (SPSS Inc/IBM, Chicago, IL, USA). Categorical variables were described by number and percent (N&%), where continuous variables were described by mean and standard deviation (Mean±SD). Chi-square and Fisher's exact tests were used to determine the differences in proportions for each variable. Analysis of variance (ANOVA) was performed to compare means of continuous variables between the two groups. P value of less than or equal 0.05 was considered significant.

RESULTS

The mean age of our patients was 42.56 and 43.39 years in group A and B respectively. The female to male ratio was the same in both groups (2.8:1). The mean BMI was similar in both groups; 31.49 and 30.86 in group A and B respectively (P= 0.5). The mean disease duration was 6.02 and 10.77 months in group A and B respectively (P= 0.005). Bilateral PF was diagnosed in 33.1% of all patients. X-ray diagnosed the presence of calcaneal spur in 82% and 68% in group A and B respectively. 11patients (18%) of group A and 6 (11%) of group B reported a history of previous injection earlier than three months. There was a significant difference between the two groups regarding the mean VAS of pain intensity during local injection which was lower in group B for male and female patients (P<0.0001) with a confidence interval (95% CI) of 7.78 -8.74 for group A and 3.76 - 4.72 for group B. At two week follow up, the recurrence of pain was found in only four patients (6.6%) of each group.
No injection related side effects or complications were noted immediately or at follow up of assessment. Demographic and clinical characteristics are shown in **table I.**

DISCUSSION

Local corticosteroid injection is a commonly used option for treatment of acute and chronic PF with proven efficacy (7,10). Several techniques have been tried to decrease the pain occurring with local injection treatments as attention diverting measures, Valsalva maneuver (22) and EMLA patches (23).
To the best of our knowledge, this is the first study to evaluate the potential anesthetic analgesic effect of D5W during the local injection for treatment of PF. Although the volume

Table I. Demographic and clinical findings of patients.

			Group A without D5W	Group B with D5W	P-vale
Age	Male		48.75±10.27(19-66)26.23%, 16 N	42.75±9.53(29-60) 26.23%, 16 N	0.097
	Female		40.36±9.34(22-62)73.77%, 45 N	43.62±9.49(28-65) 73.77%, 45 N	0.103
	Total		42.56±10.21(19-66) , 61 N	43.39±9.43(28-65) , 61 N	0.86
Disease duration	Male		5.25±3.64(1-12)	7.94±8.22 (1-24)	0.241
	Female		6.29±6.68(1-36)	11.78±12.39(1-60)	0.010
	Total		6.02±6.02(1-36)	10.77±11.50(1-60)	0.005
BMI	Male		29.69±5.45 (21-39)	28.96±4.85(23-37.4)	0.694
	Female		32.13±4.81 (22-43)	31.53±5.66(19-39)	0.589
	Total		31.49±5.06 (21-43)	30.86±5.54(19-39)	0.511
Pain Level (VAS)	Male		9.00±1.08(7-10)	4.15±2.28(1-9)	**<0.00001**
	Female		8.00±2.18(2-10)	4.28±1.98(1-9)	**<0.00001**
	Total		8.26±2.00(2-10)	4.25±2.05(1-9)	**<0.00001**
affected side	Male, N (%)	Right	5 (31%)	8 (50.0 %)	
		Lift	7(44%)	6 (37.5 %)	
		Bilateral	4 (25%)	2 (12.5%)	
		Total heel	20	18	
	Female, N (%)	Right	22 (49%)	24 (53.3%)	
		Lift	15 (33%)	15 (33.3%)	
		Bilateral	8 (18%)	6 (13.3%)	
		Total heel	53	51	
	Total, N (%)	Right	27 (44%)	32 (52.5%)	0.536
		Lift	22 (36%)	21 (34.4%)	
		Bilateral	12 (20%)	8 (13.1%)	
		Total heel	73	69	
Calcanean spur	Male, N (%)	Present	16 (80%)	13 (72%)	
		Absent	4 (20%)	5 (28%)	
	Female, N (%)	Present	44 (83%)	34 (67%)	
		Absent	9 (17%)	17 (33%)	
	Total, N (%)	Present	60 (82%)	47 (68%)	0.506
		Absent	13 (18%)	22 (32%)	
Previous Injection	Male, N (%)	Present	4 (25%)	0 (0%)	
		Absent	12 (75%)	16 (100%)	
	Female, N (%)	Present	7 (16%)	6 (13%)	
		Absent	38 (84%)	39 (87%)	
	Total, N (%)	Present	11 (18%)	6 (10%)	0.581
		Absent	50 (82%)	55 (90%)	
2 week Recurrence rate	Male, N (%)	Present	2(12.5 %)	1 (6.25 %)	
		Absent	14(87.5 %)	15 (93.75 %)	
	Female, N (%)	Present	2(4.4 %)	3(6.7%)	
		Absent	43(95.6 %)	42(93.3 %)	
	Total, N (%)	Present	4(6.6 %)	4(6.6 %)	0.641
		Absent	57(93.4 %)	57(93.4 %)	

BMI: body mass index, VAS: visual analogue sca

of the injectate was increased by the addition of 0.5ml buffered D5W, it led to a significant decrease of the pain occurring during such painful intervention.

The potential immediate analgesic effect of D5W has been demonstrated in a randomized controlled trail of epidural 10ml D5W versus normal saline injection for patients with low back pain and radiculopathy[17]. This encouraged the authors to examine the long term efficacy of D5W in those patients when serially injected every two weeks for four times. The results of long term follow up confirmed the safe effective prolonged analgesia (24).

D5W has been recently used as a primary hydrodissection injectate for many nerve entrapments in the upper body and torso with proven efficacy and cumulative pain reduction comparable to deep nerve block and with more safety profile than local anesthetic (25). Recently, D5W decreased the associating vascular pain when co-administered with bendamustine as a chemotherapeutic agent (15). Moreover, Paprottka et al reported a significant decrease of pain during and after the radioembolization procedure when they replaced the sterile water with D5W as the infusion solution for the injection of microspheres in patients with hepatic carcinoma (16).

The rationale behind the anesthetic analgesic effect of D5W is still unclear but it is hypothesized that dextrose acts at the level of pain receptors especially the transient receptor potential vanilloid receptor 1 (TRPV-1) which is up regulated by capsaicin[26]. It is also hypothesized that extra cellular dextrose elevation may hyperpolarize the normoglycemic C fibers and lowers their firing level leading to minimization of pain perception (27).

In the same context, Wolf et al mixed mannitol with local anesthetic to increase its efficacy in alveolar nerve block during dental anesthesia based on the hypothesis that it can increase the permeability of the neural membrane (19). Bertrand et al. used mannitol to decrease the pain resulting from capsaicin application in a lip pain model in a double blind, pilot- level, randomized controlled trial (28).

While our study was a single blind one, it would be more solid if the double blind technique was applied. We preferred not to add 0.5 ml. saline as a placebo in the control group to avoid the increased amount of pain resulting from increasing the volume of the injectate. This study lacked also the long term follow up to evaluate if there is a difference between the two groups regarding the long lasting efficacy. More studies are needed to support our results in different areas of enthesopathies and regional pain syndromes.

CONCLUSIONS

This study demonstrated that the addition of 0.5ml buffered D5W to the injectate can decrease the pain associated with local steroid injection for treatment of plantar fasciitis which may increase the patient's acceptance to this commonly used intervention.

FINANCIAL DISCLOSURE

We affirm that we have no financial affiliation or involvement with any commercial organization that has a direct financial interest in any matter included in this manuscript, except as disclosed in an attachment and cited in the manuscript.

CONFLICT OF INTERESTS

The authors declare no conflict of interests.

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