Comparison of phenol and alcohol neurolysis of tibial nerve motor branches to the gastrocnemius muscle for treatment of spastic foot after stroke: a randomized controlled pilot study

H. KOCABAS, A. SALLI, A. H DEMIR, O. M. OZERBIL

Aim. The aim of this paper was to determine whether the injection of alcohol or phenol into the tibialis posterior or nerve relive the symptoms and signs of ankle plantar flexor spasticity.

Methods. Twenty patients with hemiplegic stroke were included. Patients were randomly assigned to receive a single treatment of alcohol or phenol injection to the motor branches of tibial nerve. Clinical outcome parameters were measured before Motor branch block, immediately, and at 1, 3, and 6 months after blocking. These parameters included a. Ankle plantar flexor spasticity assessed by Modified Ashworth Scale, b. Clonus of the ankle; c. The passive range of motion changes measured by goniometer and d. Motor strength of the ankle plantar flexors measured by the Medical Research Council grades 0-5.

Results. In the alcohol group the spasticity score for the ankle plantar flexor was reduced in all 10 patients immediately after motor branch block and this was maintained over the 6 month follow up period in 9 patients. In the phenol group the spasticity score for the ankle plantar flexor was reduced in all 10 patients immediately after motor branch block and it was maintained over the 6 month follow up period in 7 patients.

Conclusion. It was observed that both two methods are effective in reducing spasticity however the use of 50% alcohol as a neurolytic agent in the management of ankle plantar flexor spasticity appears to be long lasting method of regional spasticity treatment.

Key words: Stroke - Tibial nerve - Muscle spasticity - Phenol - Ethanol.

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Ankle plantar flexor spasticity is a significant functional problem in patients with stroke because the condition often causes difficulty in standing and walking. Peripheral nerve blocks, by interrupting the stretch reflex arc have been shown to be an effective way of reducing spasticity when it is confined to certain muscle groups. In ankle foot spasticity, the tibial nerves may be neurolysed. Alcohol (ethanol) and phenol provide long term chemical neurolysis by destruction of peripheral nerves and improve walking by reducing plantar flexion and varus of the foot.1-3 This comparative study is the first study that was designed to determine whether alcohol and phenol relieve the symptoms and signs of ankle plantar flexor spasticity and if either of these two methods offers several advantages and disadvantages over the other.

Phenol affects similar to a local anesthetic at low concentrations (<<2%). At concentrations higher than 3% it causes protein denaturation and axonal degeneration with inflammation of the nervous tissue which leads to neural destruction. Injection also causes occlusion and fibrosis in microcirculation around the nerve.4, 5

Alcohol causes tissue destructions such as nerve coagulation and muscle necrosis by denaturating proteins but its effect changes due to its concentration. At low concentrations (5-10%) it blockades sodium and
potassium canals and acts as local anesthetics. When 35% alcohol was applied onto nerves in animals, demyelization, mostly in small fibers, was seen with no axonal damage. And with 50-100% concentrations it causes paralysis with producing neuronal Wallerian degeneration and fibrosis.4, 6

Materials and methods

Participants

Twenty patients with hemiplegic stroke (14 men; 6 women) were selected according to the following criteria:

1) severe ankle plantar flexor spasticity in the knee extension state (Modified Ashworth Scale (MAS) 7 score ≥2);

2) limitations on walking or standing due to ankle plantar flexor spasticity;

The exclusion criteria were cases that had:

1) undergone previous neurolytic procedures (including botulinum toxin);

2) rigidity, dystonia, fixed soft tissue contractures or fixed structural deformities of the ankle and foot;

3) deep vein thrombosis of the affected lower extremity;

4) a history of adverse reactions to alcohol or phenol.

This study was a randomized comparison of alcohol and phenol blockade in the patients with lower limb spasticity after stroke. Simple randomization method with pitch and toss was used for randomization.

All of the patients had been trained within same intensive rehabilitation programs before their admission into the study. They did not receive intensive rehabilitation during the study; they performed only stretching exercises and walking examinations that were shown to them in order to not lose range of motion which was gained from the injection. No one was taking oral antispastic drugs during the course of the study. Only using of paracetamol was allowed for pain.

The Local Ethical Committee approved this study, and all the subjects gave their written informed consent prior to their inclusion.

Injection technique

The motor branches originate from the trunk of the tibial nerve obliquely at the mean of 3.3±1.2 cm proximal to the horizontal line to the upper margin of the fibular head.8 Patients were placed in the prone position. The knee was flexed to allow palpation of the superior popliteal fossa borders and identification of the skin crease behind the knee joint.9 The intersection point of medial and lateral gastrocnemius muscle which is the upper border of the popliteal fossa was marked. A vertical line was drawn along this point to the horizontal line. This line shows the reflection of the trunk of the tibial nerve. The motor branches were localized as about 1 cm medial or lateral side of the tibial nerve. We used these points as the needle insertion points (Figure 1).

The skin was cleaned with Betadine iodine. All procedures were performed by the same clinician using a Braun Stimuplex HNS 11 nerve stimulator. Teflon coated, 22 gauge needle was introduced perpendicular to the skin. The needle was connected to an injection tube which bore the syringe containing alcohol or phenol. The hub of the needle was connected to the nerve stimulator which was able to deliver a maximum current of 1 mA. The needle was slowly advanced until maximum contraction of the
muscles was achieved with the minimum amount of current. Stimulus frequency was 1 Hz and stimulus duration was 1ms. We obtained maximum contractions between 0.15-0.20 mA intensity in our patients. The depth of the needle was approximately 1 to 3cm. Five mL of 5% phenol or 5 mL 50% ethyl alcohol was injected slowly, after ensuring that the needle aspirates was negative for blood. To minimize pain during the injection of alcohol, small volumes of 1% lidocaine were added to the injectate.

Outcome measures

Clinical outcome parameters were measured before Motor branch block (MBB), immediately after MBB, and at 1, 3, and 6 months after MBB. These parameters included a. Severity of ankle plantar flexor spasticity, as measured by the MAS, which was scored as 0, 1, 2, 3, or 4; b. The clonus score of the ankle, scored as 0 (absent), 1 (unsustained), 2 (sustained), and 3 (spontaneous/light touch provoked). c. The values belonging to pre MBB were accepted as zero and the passive range of motion (PROM) changes and d. Motor strength of the ankle plantar flexors, as measured by the Medical Research Council grades 0-5.

Statistical analysis

Statistical analysis was performed by Statistical Package for Social Sciences (SPSS version 13). A non-parametric test (Friedman test) was used to compare means, especially repeated-measures analysis of variance. Among group analysis were performed using the Mann Whitney U test at all scheduled visits. The level of significance for all tests was accepted when P was less than 0.008 according to Bonferroni correction.

Results

Demographic variables

In the alcohol group there were 8 men and 2 women. The mean age was 55.60±13.69 years (range 29-74), mean duration passed from stroke date was 21.40±16.03 months. Six men and 4 women were taken to the phenol group. The mean age was 51.90±11.49 years (range 32-72), mean duration passed from stroke date was 22.80±27.67 months. All of the patients were ambulant with aids and/or assistance. There were no significant differences in sex, mean age, duration passed from stroke date and etiology of stroke (P>0.05) (Table I).

Clinical variables

ALCOHOL GROUP

The MAS score for the ankle plantar flexor was reduced in all 10 patients immediately after MBB and this was maintained over the 6-month follow-up period in 9 patients (90%). The pre-MBB level of spasticity reappeared 1 month after MBB in one patient (Table II) (P<0.008).

Of the 10 patients injected with alcohol 3 patient had no clonus, 5 patient had unsustained and 2 patient had sustained clonus. The clonus score was reduced immediately in 3 patients, 1 month after MBB in 2 patients, at 6 months after MBB in 1 patient. No change was determined in one patient. Ankle clonus reappeared only in one patient 1 month after MBB. But these decrements were not statistically significant (Table II) (P>0.008).

The mean PROM for ankle dorsiflexion was significantly increased (Table II) (p<0.008).

Although an increase in muscle strength was determined, it was not significant.

PHENOL GROUP

In the phenol group, similar to alcohol injection the MAS score for the ankle plantar flexor was reduced in all 10 patients immediately after MBB. But this was maintained over the 6 month follow up period in 7 patients (70%). The pre-MBB level of spasticity reappeared at 1 month after MBB in two patients and at 6 months after MBB in 1 patient (Table III) (P<0.008).

From the 10 patients injected with phenol, 5 patients had no clonus, 3 patients had unsustained and 2
KOCABAS

COMPARISON OF PHENOL AND ALCOHOL NEUROLYSIS OF TIBIAL NERVE MOTOR BRANCHES TO THE GASTROCNEMIUS MUSCLE

Table II.—Changes of clinical parameters in alcohol group.

<table>
<thead>
<tr>
<th></th>
<th>Pre MBB</th>
<th>Immediately post MBB</th>
<th>Pa1</th>
<th>1 month post MBB</th>
<th>Pa2</th>
<th>3 month post MBB</th>
<th>Pa3</th>
<th>6 month post MBB</th>
<th>Pa4</th>
</tr>
</thead>
<tbody>
<tr>
<td>MAS score</td>
<td>2.70±0.48</td>
<td>1.80±0.63</td>
<td>0.003</td>
<td>1.60±0.51</td>
<td>0.005</td>
<td>1.40±0.69</td>
<td>0.006</td>
<td>1.40±0.69</td>
<td>0.006</td>
</tr>
<tr>
<td>Clonus score</td>
<td>0.90±0.73</td>
<td>0.60±0.69</td>
<td>0.083</td>
<td>0.50±0.85</td>
<td>0.046</td>
<td>0.50±0.85</td>
<td>0.046</td>
<td>0.40±0.69</td>
<td>0.025</td>
</tr>
<tr>
<td>PROM changing (degree)</td>
<td>0</td>
<td>10.50±4.34</td>
<td>0.004</td>
<td>14.00±7.37</td>
<td>0.004</td>
<td>14.50±8.95</td>
<td>0.007</td>
<td>13.00±6.32</td>
<td>0.007</td>
</tr>
</tbody>
</table>

Statistical significance in alcohol group.
Pa1: between pre MBB and immediately post MBB
Pa2: between pre MBB and 1 month post MBB
Pa3: between pre MBB and 3 month post MBB
Pa4: between pre MBB and 6 month post MBB

MAS: Modified Ashworth Scale; MBB: motor branch block; PROM: the passive range of motion.

Table III.—Changes of clinical parameters in phenol group.

<table>
<thead>
<tr>
<th></th>
<th>Pre MBB</th>
<th>Immediately post MBB</th>
<th>Pa1</th>
<th>1 month post MBB</th>
<th>Pa2</th>
<th>3 month post MBB</th>
<th>Pa3</th>
<th>6 month post MBB</th>
<th>Pa4</th>
</tr>
</thead>
<tbody>
<tr>
<td>MAS score</td>
<td>2.70±0.48</td>
<td>1.10±0.87</td>
<td>0.005</td>
<td>1.20±0.93</td>
<td>0.007</td>
<td>1.20±1.13</td>
<td>0.004</td>
<td>1.60±0.96</td>
<td>0.006</td>
</tr>
<tr>
<td>Clonus score</td>
<td>0.80±0.78</td>
<td>1.10±0.31</td>
<td>0.02</td>
<td>0.10±0.31</td>
<td>0.02</td>
<td>0.10±0.31</td>
<td>0.02</td>
<td>0.30±0.48</td>
<td>0.59</td>
</tr>
<tr>
<td>PROM changing (degree)</td>
<td>0</td>
<td>11.00±6.17</td>
<td>0.007</td>
<td>11.50±9.44</td>
<td>0.009</td>
<td>15.50±13.42</td>
<td>0.008</td>
<td>12.50±10.34</td>
<td>0.008</td>
</tr>
</tbody>
</table>

Statistical significance in alcohol group.
Pa1: between pre MBB and immediately post MBB
Pa2: between pre MBB and 1 month post MBB
Pa3: between pre MBB and 3 month post MBB
Pa4: between pre MBB and 6 month post MBB

MAS: Modified Ashworth Scale; MBB: motor branch block; PROM: the passive range of motion.

Patients had sustained clonus. The clonus was lost in 4 patients and decreased from sustained level to unsustained level in 1 patient. Ankle clonus reappeared only in one patient at 6 months after MBB. But these decrements were also not statistically significant (Table III) (P>0.008).

The mean PROM for ankle dorsiflexion was increased immediately post-MBB (P=0.007) but it started to decline by the end of the first month (P>0.008) (Table III).

No change in motor strength of the ankle dorsal flexors was observed in 8 of 10 patients. Only 2 patients showed motor strength increase.

Functional improvements after neurolysis were assessed by visual analysis of gait in both of the groups. All 20 patients had visible improvement in gait. Two patients in alcohol group and one patient from phenol group who initially required an AFO for ambulation were able to discontinue use of their orthosis an average of 3 months after neurolysis. Furthermore, we observed that other patients need to assistive devices or assistance for ambulation lessened compared to preinjection period.

When we compare two groups, there was no significant differences between the groups with regard to MAS, clonus, PROM gain values and muscle strength (P>0.008).

The commonest complication seen in both groups was local post injection pain which occurred in all patients and resolved after 24-48 hours and it was the same in both groups. Delayed complications included dysesthetic pain, sensory loss in the sole of the foot, and distal limb swelling were not seen in alcohol group. Only one patient who was in phenol group complained from dysesthetic pain. It was severe therefore we needed to use gabapentin 2 400 mg/ day to resolve this pain. This pain resolved completely after 3 months from injection.

Discussion

To our knowledge our study is the first that compares the efficacy, advantages and disadvantages of alcohol and phenol. In our study we found that both phenol and alcohol are effective for the treatment of
effects of alcohol on siciatic, tibial and median nerves

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in another area.

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in another area.

Phenol neurolysis of peripheral nerves for spasticity

has been well described in the literature as a neu-

rolytic agent for the past 30 years.1, 11 On et al.,12

describe the effects of phenol injection on peripheral

nerves. They postulate that the involvement of the

alpha motor fibers within the tibial nerve was the most

likely factor contributing to the reduction of spasticity

after the phenol blockade, and the effect might be

partly ascribed to the involvement of Ia afferents and

to a lesser degree of gamma motor fibers.

Kirazli et al.,13 compared botulinum toxin type A

motor point injection to phenol neurolysis of tibial

nerve in 20 spastic foot after stroke. They found sig-

nificant improvement in the Ashworth score for dor-
siflexion in both groups, but the changes were more

significant in the group that received botulinum tox-
in Type A at weeks 2 and 4, whereas there was not a

significant difference between the two groups at weeks

8 and 12. In our study, 7 patients from phenol group

had significant improvement in spasticity and this

improvement prolonged up to 6 months. Botulinum

toxin injection is one of the newest method in the

treatment of spasticity. But the most important obstacle

on the wide usage of toxin is not exceed the max-

imum dose rather than very high cost. Therefore, uti-

lization rate is falling, especially in adults.3

The majority of studies using alcohol were con-

fined to motor point blocks and intramuscular wash-
es in the pediatrics cerebral palsy population.14, 15

These studies report that the effect of alcohol con-
tinues usually 6-12 months, and in some cases it pro-
longs up to 3 years. There have been few studies

using alcohol to neurolyse peripheral nerves.6, 16, 17

Pelissier et al.,16 was the first to describe the clinical

effects of alcohol on siciatic, tibial and median nerves

in 27 patients with hemiplegia by using 60% alcohol,

with varying degrees of improvement for up to 4

months.

In a recent study,8 clinicians determined the effec-

tiveness of alcohol neurolysis of the motor branches

of the tibial nerve to the gastrocnemius muscle for

the treatment of ankle plantar flexor spasticity in

patients with hemiplegic stroke. The MAS score was

reduced in 17 of 22 patients during the 6 month fol-

low up. Therefore alcohol neurolysis was found to be

effective for relieving localized spasticity of the ankle

plantar flexors. Like this study the MAS score reduced

in 9 of 10 patients from alcohol group during the 6

month follow up in our study.

The safety profile of alcohol compared with phenol

has been well alluded to with relatively few reports of

adverse effects following intramuscular and perineural

alcohol injections as compared to phenol,18, 19 Systemic

complications of phenol usually occur from acciden-
tal intravascular injection which may result in poten-
tially fatal cardiac dysrhythmias, hypotension, cardio-

vascular collapse, seizures and respiratory depres-
sion.2 In addition, phenol can create serious vascular

and nerve lesions.3 The incidence of post injection

dysesthesias in the published literature following phe-

nol blocks range from 2-32% and this is more then the

ratio seen in alcohol.2, 13 In addition better stability,
ease of preparation, and greater flexibility in the tim-
ing of injections make alcohol generally easier to use.

In our study no serious complications were observed

in both groups. Only one patient from phenol group

complaint to dysesthetic pain.

The result of this randomized study indicates that

both alcohol and phenol neurolysis reduce lower

limb spasticity in post stroke patients. For plantar flex-
or spasticity there was not a significant difference

between two groups. Our patients who were in alco-

hol group showed improvement in ankle plantar spas-
ticity and this improvement was maintained for at

least 6 months. In addition, the complications were

minimal and transient in this group.

Not planning the study as double blind study pro-

cedure, following the patients for only 6 months and

not using objective scales to assess ambulation are

the major limitations of this study.

We believe that long term follow-up of a larger

group of subjects is necessary in future studies.

Therefore, the effect, the period of effectiveness, long
term complications and effectiveness of the proce-
dure in terms of cost and time should be elucidated.
Conclusions

In conclusion it was seen that tibial neurolysis by either phenol or alcohol is effective in reducing plantar flexor spasticity. However use of 50% alcohol as a neurolytic agent in the management of ankle plantar flexor spasticity appears to be long lasting method of regional spasticity treatment. Both alcohol and phenol treatments are cheap methods with respect to botulinum toxin. So they can be chosen for patients who have no health insurance and can’t pay drug cost. More suitable preparation and storage and effectiveness as phenol can lead to alcohol preference.

References