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Ultrasound Guided Phenol Block of the Obturator Nerve for Severe Adductor Spasticity: A Pilot Study

Ayman Alsuhabani[1,2], **Karen Ethans**[1,3*], **Alan Casey**[1,3], **Ryan Skrabek**[1,3], **Dan Chateau**[1] **and Eric Sutherland**[1,3]

[1]*Faculty of Medicine, University of Manitoba, Canada*

[2]*King Fahad Medical City, Riyadh, Saudi Arabia*

[3]*Rehabilitation Hospital, Health Sciences Centre, Canada*

[*]**Corresponding author:** Karen Diane Ethans, Department of Internal Medicine, Faculty of Medicine, University of Manitoba, Canada, Tel: 12047872206; E-mail: kethans@exchange.hsc.mb.ca

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Abstract

Objective: To assess the efficacy of phenol block of the obturator nerve in treating severe adductor spasticity.

Design: A prospective pilot study.

Setting: Outpatient rehabilitation clinics.

Participants: We recruited 5 participants with severe adductor spasticity. Four were persons with multiple sclerosis and one was a person with adult cerebral palsy. All participants were women and had an average age of 60.4 years; four participants had bilateral severe adductor spasticity and one had unilateral severe adductor spasticity.

Interventions: A total of 9 phenol blocks of the obturator nerve were performed. Five were performed with ultrasound guidance, followed by localization of the obturator nerve by peripheral nerve stimulator. Four were performed using anatomic landmark and peripheral nerve stimulator for localization.

Outcome Measures: The primary outcome measure was the Modified Ashworth Scale score of the hip adductor at 1 month after the obturator nerve block. The secondary outcomes measures include Modified Ashworth Scale (MAS) score of the hip adductors at 6 months, distance between the right and left medial femur condyles in supine with hip extended to neutral, Disability Assessment Scale (DAS) score, Goal Attainment Scale (GAS) score, Spasticity Numeric Rating Scale score and Subjects' and Physician Global Impression of Changes scores.

Results: There was statistically significant decrease in the MAS score at 1-month compared to baseline (2.43 vs. 4; P=0.001). There was no statistically significant difference in the secondary outcomes. There were no reported adverse effects of procedure.

Conclusion: This study suggests that phenol block of the obturator nerve is effective in treating severe adductor spasticity. We recommend a larger study with more participants and longer follow up period to allow further assessment of the efficacy of the phenol block of the obturator nerve in treating severe adductor spasticity.

Keywords: Phenol; Adductor spasticity: Obturator nerve; Rehabilitation; Ultrasound

Introduction

Spasticity is defined as "a motor disorder that is characterized by a velocity dependent increase in tonic stretch reflexes (muscle tone) with exaggerated tendon jerks, resulting from hyperexitability of the stretch reflex, as one component of the upper motor neuron syndrome" [1]. This upper motor neuron syndrome (UMNS) is caused by a lesion in the central nervous system such as with the spinal cord, brainstem, or brain. Signs of UMNS include: paresis, loss of fine dexterity, fatigability (so-called "negative signs") and spasticity, overactive reflexes, and contractures (so-called "positive signs").

Pharmacological options for treating spasticity include such medications as baclofen, tizanidine, clonidine, and benzodiazepines. Physical measures, such as range of motion exercise and stretching, are often conducted to minimise loss of joint range, a common problem associated with spasticity. Botulinum toxin is the treatment of choice if the spasticity is focal or multifocal [2]. Nerve blockade and neurolysis could also be considered. If the spasticity is diffuse, one could consider intrathecal baclofen for severe, problematic spasticity not amenable to tolerable doses of oral medications.

Peripheral nerve blocks with chemical agents such as phenol and alcohol have been shown to be effective in reducing spasticity, especially when it is confined to certain nerves [3,4]. Phenol is non-selectively neurolytic and the degree of neurolysis correlates directly with the concentration and the total amount used [4]. Phenol exerts

short and long-term effect on the nerves. The short-term effect is directly proportional to the thickness of the nerve fibers, the long-term effect is achieved through protein denaturation [5], which results in Wallerian denervation [5]. The primary advantages of phenol neurolysis are the extremely low cost and long-lasting effect (6 weeks to 18 months) [4,6-9]. Since the widespread availability of botulinum toxin for spasticity has occurred in the last 1-2 decades, however, phenol neurolysis is not commonly performed, mostly because it has much higher perceived risk of side effects than botulinum toxin, in particular dysesthesias, numbness, hematoma and local pain. As well the injection procedure is more challenging, with increased technical difficulty [4,7]. When phenol has been reported to be used, different amounts volumes used range between 0.2–10 mL in a various concentrations of 3 – 12% [4,7,8]. Both concentration and volume alter phenol effects; 5% phenol has a more prolonged effect than 3% and 0.3 mL is more effective than 0.1 mL [10].

Ultrasound has been shown to facilitate the identification of nerves, reduce complications [11,12] and allows real-time monitoring of the local anaesthetic solution spread [11-13]. Recently many articles in the anaesthesia literature have studied using US guided obturator nerve (ON) block with nerve stimulation to improve analgesia for knee surgery and for urological procedures [14,15]. Sonographic view of the obturator nerve shows a hyperechoic flat or lip-shaped appearance (connective tissue network) with discrete internal hypoechoic dots (fascicles). This guidance procedure has been reported to be technically easy, making ON block much easier, faster, and highly successful [14-16], and it can be performed with minimal ultrasound training [16]. The success rate of ultrasound and nerve stimulated guided ON block for knee surgery reached up to 100% in one study [17].

The aim of this study was to evaluate the effectiveness of phenol obturator nerve (ON) block on severe adductor spasticity. A secondary objective of the study was to assess the feasibility of using ultrasound to guide the ON block procedure. Lastly, we have applied the Disability Assessment Scale (DAS) to the hip, and report the use of it for such here.

Methods

This is a prospective pilot study with 5 participants recruited from the Spasticity Clinic in our hospital. Participants were seen for follow-up at 1, 3 and 6 months after treatment of spasticity. This study was evaluated and approved by the local research ethics board (#B2011:015) and registered with clinicaltrials.gov.

Participants

The inclusion criteria were as follows: participants age between 18 and 70 years old, any gender, grade 3 spasticity on Modified Ashworth Scale of the hip adductors from an upper motor neuron lesion, (including those with MS, SCI, Stroke, and adult CP), and use of any anti-spasticity medications at stable doses for at least 1 month prior to enrolment, and the participant has to agree to maintain same dose throughout the study. The exclusion criteria were as follows: botulinum toxin to the hip adductors in the past 6 months, people that are able to walk (to ensure no loss of function that could be irreversible), and evidence of fixed joint contracture.

Intervention

The ON block was carried out using ultrasound guidance to visualize the ON in one side. Once the ON was visualized, the location of ON was confirmed by peripheral nerve stimulator with a 22 G teflon-coated needle. Accurate location of the ON was confirmed when the adductor muscle contracted in response to a 0.7 mA stimulation or less. In 4 of 5 subjects who had severe adductor spasticity bilaterally, the contralateral ON was identified by anatomical landmarking and peripheral nerve stimulator confirmation. The ON block was performed by using either 3 cc of 5% phenol with the first 2 participants and 2.5 cc of 6% phenol for the rest. This slight variation in the phenol concentration was due to supply issue, but the same total dose per injection was used.

Outcome Measures

Baseline values collected before the ON block procedure included the Modified Ashworth Scale (MAS) score for adductor muscle spasticity, Disability Assessment Scale (DAS) score of the hip, and the distance between the right and left medial femur condyles in supine with hip extended to neutral. The primary outcome was MAS score of the hip adductor at 1 month post ON block. The MAS is the current standard for clinical assessment of the spasticity, and the most commonly used tool to evaluate the efficacy of pharmacologic and rehabilitation interventions for treatment of spasticity [18]. The scale grades resistance to rapid passive movement across a relaxed joint on a six-category ordinal scale [18].

The secondary outcome measures include (1) MAS score of the hip adductors at 6 months, (2) Distance between the right and left medial femur condyles in supine with hip extended to neutral, (3) DAS score, (4) Goal Attainment Scale (GAS) score applied to the hip, (5) Spasticity Numeric Rating Scale score, (6) Subjects' Global Impression of Change score, (7) Physician Global Impression of Change score.

The distance between the right and left medial femur condyles in supine with hip extended to neutral has been used as an outcome measure for the treatment of hip adductor spasticity [19]. This is the measure of distance in centimetres between the right and left medial femoral condyles while the subject is supine and hips and the knees are in maximum possible passive extension. Four areas of functional disability and impairment are commonly assessed by DAS in patients with spasticity (hygiene, pain, dressing and limb position) [20]. These areas are rated by the four-point DAS, ranging from 0 indicating no disability and 3 indicate severe disability. This scale was applied specifically to the hip. GAS delivers reliable and valid scores when employed as an outcome measure in working age and older people within a physical and neurological rehabilitation environment [21]. The following goals were assessed: ease of perineal hygiene, ease of lower body dressing and ease of sitting on a wheel chair. The GAS was modified slightly to ensure consistent nominal values applied to each number. A score of -1 indicated where the subject saw herself pretreatment at baseline, in conjunction with the care-giver's input, if applicable. After treatment, each goal was examined by the investigator in collaboration with the subject and caregiver. Achievement ratings as follows: at the expected level (score of 0), less than expected (-1, no change from baseline; -2, less than baseline) or more than expected (+1, more; +2, much more). Spasticity numeric rating scale is a 0 to 10 scale were 0 indicates no spasticity and 10 indicates severe spasticity. All participants were asked to rate their spasticity in the last 24 hours at each clinic visit, i.e., at baseline, 1 month, 3 months, and 6 months.

Subject and Physician Global Impression of Changes is a questionnaire asking the participant and the physician respectively to rate his or her impression of the effect of the procedure in 7 categories from Terrible to Delighted where 7 indicated the most delighted effect. This was conducted at the 1 month, 3 month and 6 month visits.

Statistical Analysis

All analyses were performed using SPSS version 20. The comparison between MAS at baseline and 1 month and baseline and 6 months was done with Fisher's Exact Test with $\alpha = 0.05$. The comparison of the secondary outcomes was done with Wilcoxon Signed Rank Test; non-parametric tests were used due to the small sample size and non-normally distributed data.

Results

The enrolled participants were diagnosed with multiple sclerosis (n = 4) and adult cerebral palsy (n = 1). A total of 9 phenol blocks of the ON were performed. All 5 participants were women with an average age of 60.4 years. 4 participants had bilateral severe hip adductor spasticity and one participant had unilateral severe adductor spasticity. None of the participants was able to walk. A total of 9 phenol blocks of the ON were performed. We attempted 5 US guided phenol block but we were not able to visualize the ON under the US in one participant. Ultimately, we performed 4 US guided ON block and 5 ON block using the anatomic landmark and stimulator confirmation.

There was statistically significant improvement in MAS score at 1-month compared to baseline (2.43 vs. 4; p=0.001). MAS scores returned close to baseline at 6-months (3.33 vs. 4; p=0.082) (Table 1).

The distance between the right and left medial femur condyles in supine with hip extended to neutral had increased at 1 month after the ON block compared to baseline but didn't reach statistical significance, although likely most clinicians would agree that the change was clinically significant (42.4 cm at 1 month vs. 33.7 cm at baseline; p=0.068).

Outcome Measure	Mean at baseline	Mean at 1 month	P	Mean at 3 months	Mean at 6 months	P
MAS score (0-5)	4.00	2.43	0.001	2.67	3.33	0.082
Distance between right and left femoral condyles	33.7	42.4	0.068	39.4	36.2	0.225
DAS: Hygiene	2.0	1.0	0.102	1.6	1.2	0.102
Pain	1.60	1.20	0.157	1	1.20	0.157
Dressing	1.80	1.00	0.102	1.00	1.40	0.157
Lower limb position	2.20	1.60	0.083	1.60	1.40	0.046
GAS: Per. Hygiene	-1.0	0.00*	0.059	0.00*	-0.40	0.180
Lower limb dressing	-1.0	0.20	0.034	-0.80	-0.80	0.317
Sitting on W/C	-1.0	-0.20	0.059	-0.40	-0.40	0.083
Spasticity numeric rating scale	5.9	3.0	0.104	3.4	4.9	0.176
Subject global impression of changes	NA	4.4		4.4	4.6	
Physician global impression of changes	NA	5.6		5.2	5.0	

Table 1: Comparison of Outcome Measures * Although the changes were not statistically significant, actually it is clinically significant as 0 on GAS indicates goal is met "as expected".

The distance reduced gradually during the study time to near baseline at 6 months (33.7 cm vs. 36.2 cm at 6 months p=0.225). There was some missing data, as we did not have the result of MAS score and the distance between the right and left medial femur condyles in supine with hip extended to neutral at 1-month on one subject.

For the DAS, subjects reported an improvement in the ease of perianal hygiene, improvement of pain, improvement in difficulty of dressing, and improvement in lower limb positioning at 1 month, but none of these reached statistical significance (Table 1). Spasticity on the Numeric Rating Scale reduced at 1 month compare to baseline (5.9 vs. 3) but was not significant. This gradually returned to near baseline at 6 months (5.9 vs. 4.9).

Comparison of all DAS scores at baseline and 1 month and at baseline and 6 months revealed all measures improved but did not reach statistical significance (P>0.05). Similarly, the Spasticity Numeric Rating scale score improved at all-time points from baseline but none of the changes on the scale was statistically significant (Table 1).

As for the GAS, the participants were able to reach their goal as expected with respect to ease of perineal hygiene at 1 and 3 months, and slightly better than expected with ease of lower limb dressing at 1 month (mean 0.20; p=0.034). Ease of seating in a wheelchair did not reach expected levels at any time point.

In terms of Participants and Physicians Global impression of changes, they both reported a satisfactory result of the ON block at 1 month (4.4 and 5.6 respectively). This satisfactory impression of changes continued at 6 months (4.6 and 5).

In general phenol blocks of the ON using 3 cc 5% phenol or 2.5 cc 6% phenol per side was tolerated well by all subjects. No adverse events

were reported by the participants nor observed by the clinician during physical examination as a result of the ON block.

Discussion

In this study we found a significant reduction in MAS score of hip adductor spasticity in persons with severe adductor spasticity 1 month after phenol ON block. Most effects of the ON block lasted for up to 6 months, but were not statistically significant.

There are a limited number of reports concerning the cases treated with ON neurolysis. Akkaya et al. performed ON block using phenol in patients with severe hip adductor spasticity. They reported that the decrease in spasticity lasted for about 3 months [4]. One of the main reasons for the use of phenol neurolysis falling out of favour in the past 1-2 decades was the concern of developing dysesthesias in the distribution of the treated nerve. However, the obturator nerve has very little in the way of cutaneous sensory distribution, thus some clinicians throughout the world still routinely use phenol for neurolysis of the obturator nerve to relieve adductor spasticity [4,5,7]. None of the participants in this study reported dysesthesias. This could be due to the participant's baseline reduced sensation in the lower extremities or the obturator nerve's small cutaneous sensory distribution.

Botulinum toxin is effective in treating focal and multi-focal spasticity without significant systemic side effects [2]. However, botulinum toxin is extremely costly, and needs to be repeated every 3-6 months. Maximum dose recommendations and cost prohibit clinicians from adequately treating people with multi-focal spasticity consistently. This is particularly problematic in patients who have numerous problematic areas of the body that need spasticity treatment. Therefore, in these cases, clinicians and their patients are forced to be selective in the doses and/or muscles that they treat with botulinum toxin, and may not have the desired effect of treating many problematic areas. The advantages of phenol ON block are its relative low cost and effectiveness in treating spasticity. Furthermore, the obturator nerve has limited cutaneous sensory distribution, thus reducing the probability of dysesthesia. Another advantage of performing ON block is that it can be combined with botulinum toxin in treating multifocal spasticity, giving the clinician the chance to treat more muscle groups with botulinum toxin.

In our study we found that visualization of the ON under the US was often challenging. This could be due to many factors. Changes in the muscle structure after a chronic neurological injury make it more challenging to differentiate between the nerve and the sclerotic muscle fibers. Another factor is that all the subjects have severe adductor spasticity which interferes with optimal positioning for successful US probe placement in order to visualize the ON. However, we did find it useful for visualizing other structures, including ones we wanted to avoid (femoral neurovascular structures), and ones we wanted to use as landmarks (adductor longus, brevis, and magnus muscles).

As far as we know, this is the first study exploring the use of the Disability Assessment Scale to the hip specifically. However, it is, in our opinion, a good one to use given that it addresses all the major concerns seen in adductor spasticity of the hip in patients that are not able to walk, specifically dressing, hygiene, pain, and positioning. We recommend further study in this area to advance the ability to assess spasticity chemodenervation treatments for the hip adductors, namely botulinum toxin and phenol or alcohol.

Our application of the GAS was not conventional; we used the same three goals (perineal hygiene, lower limb dressing, and sitting in wheelchair) in all participants, which were done to ensure consistency in the study. However, this approach takes away from some of the usefulness of GAS, i.e., to individualize goals. Interestingly, the only goal that didn't reach "as expected" was sitting in a wheelchair, whereas "lower limb positioning" was better on the DAS at 6 months.

There were a few study limitations. The design of this study as a pilot study and limited statistical power with such a small sample size made this study a preliminary study to explore the efficacy of phenol ON block. All of the measures showed some improvement, although most were not statistically significant, likely due to type 2 error. One could argue that many of these results were clinically significant however, as most of the measures were improved by at least 20%. For example, the GAS didn't reach statistical significance in improvement in hygeine, but the patients did reach the goal "as expected" by reaching 0, which is a positive outcome. In fact, all of the participants requested retreatment at least once after the study was over once the effects wore off as they were pleased with the results. Another limitation of the study is that most of the participants have some cognitive deficits and most of the secondary outcomes in this study are subjective, which make it difficult to rely on the participants reporting the changes. However, in these cases, we also had the care-givers to assist with reporting of outcomes such as ease of perineal hygiene. Being a pilot study, there were no placebo-controlled subjects. However, given that the adductor spasticity was severe in these patients, it would be difficult to justify withholding therapy to give placebo in this setting.

Conclusions

This prospective pilot study suggests that phenol ON block is effective in treating severe adductor spasticity. It is of a very low cost, and can be used in patients for whom botulinum toxin is needed for other muscle groups. The number of participants in this study is small, thus we recommend a larger study with more participants and a longer follow up period, perhaps comparing to intramuscular botulinum toxin injections, to allow further assessment of the efficacy of the phenol ON block in treating severe hip adductor spasticity. DAS seems to be an appropriate tool to use for assessing effectiveness of treatment for hip adductor spasticity and is therefore recommended for consideration in future studies on this area.

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