Evaluation of interadductor approach in neurolytic blockade of obturator nerve in spastic patients

Anju Ghai,
Sukhbir Singh Sangwan[1],
Sarla Hooda, Nidhi Garg,
Zile S. Kundu[1], Tushar Gupta

Departments of Anaesthesiology and Pain Clinic, [1]Orthopedics and Rehabilitation, Pt. B. D. Sharma PGIMS, Rohtak, Haryana, India

Address for correspondence:
Dr. Anju Ghai,
Department of Anaesthesiology and Pain Clinic, Pt. B. D. Sharma, PGIMS, Rohtak, 19/9 J,
Medical Enclave, Haryana, India.
E-mail: dr.wadhera@yahoo.com

ABSTRACT

Background: Spasticity is a syndrome associated with a persistent increase in involuntary reflex activity of a muscle in response to stretch. Adductor muscle spasticity is a common complication of spinal cord and brain injury. It needs to be treated if it interferes with activities of daily living and self-care. Obturator neurolytic blockade is one of the cost-effective therapeutic possibilities to treat spasticity of adductor group of muscles. In this study, we assessed the efficacy of interadductor approach in alleviating the spasticity. **Methods:** Obturator neurolysis using 8-10 ml 6% phenol was given with the guidance of a peripheral nerve stimulator in 20 spastic patients. Technical evaluation included number of attempted needle insertions, time to accurate location of the nerve, depth of needle insertion, and success rate. Pain, spasticity, hip abduction range of motion (ROM), number of spasms, gait, and hygiene were evaluated at 1st hour, 24th hour, end of the 1st week, and in the 1st, 2nd, and 3rd months following the intervention. **Results:** The success rate was 100% with mean time to accurate nerve location 4.9±2.06 min. Average depth of needle insertion was 2.91±0.32 cm. Compared with the scores measured immediately before the block, all studied parameters improved significantly. An increase in the Modified Ashworth Scale values was observed in the 2nd and 3rd months, but they did not reach their initial values. **Conclusion:** The interadductor approach proved to be accurate and fast, with a high success rate. Phenol blockade is an efficient and cost-effective technique in patients with adductor spasticity. It led to a decrease in spasticity and pain with an increase in the ROM of the hip and better hygiene, with an efficacy lasting for about 3 months.

Key words: *Hip adductor spasticity, obturator nerve block, phenol, spinal cord injury*

INTRODUCTION

Spasticity is a major challenge to the rehabilitation team. It is defined as a motor alteration characterized by muscle hypertonia and hyperreflexia – both depending on the speed of muscle stretching movement – associated with other clinical conditions occurring from upper motor neuron injury. Adductor muscle spasticity is an important complication of brain traumas, brain infarction/hemorrhage, neurodegenerative disorders, and cerebral palsy.[1] Left untreated, it gives rise to many problems, such as pain, spasms, limb contracture, and deformity.[2] It interferes with physical activity, interrupts sleeping pattern, leads to contractures, and limits the degree of independence. In patients who are ambulatory, excessive scissoring of the hips results in an inefficient gait and also increases the risk of falling. Thus, treatment is usually desirable, but it is difficult to treat spasticity successfully. The aims of treatment should be to improve function, to reduce the risk of unnecessary complication, to alleviate pain, and to assist with the maintenance of hygiene, dressing, and transferring.[3]

Access this article online	
Quick Response Code:	Website: www.saudija.org
	DOI: 10.4103/1658-354X.121074

The most primary approach consists of improving the patient's posture and positioning. Physiotherapy is vital for correct positioning, seating, use of orthoses, splints, and casts, and for other antispastic measures. This must be provided before, during, and after any pharmacological intervention.[2]

Specific treatment choices include oral medications in the form of centrally acting muscle relaxants like baclofen, diazepam, dantrolene, and tizanidine, interventional treatment like intrathecal baclofen pump and neurolysis, and surgical interventions.[2] The use of muscle relaxant drugs is usually considered for spasticity with severe impairment in global motor function, but is associated with side effects like nausea, diarrhea, sedation, fatigue, dizziness, lowering of the seizure threshold, hepatotoxicity, withdrawal symptoms, and cognitive dysfunction.[4] Intrathecal baclofen therapy is indicated for patients with severe and refractory spasticity and is associated with complications like muscle weakness, somnolence, catheter malfunction, pump failure, pump delivering an overdose of baclofen, risk of respiratory depression, and complications of the intervention, and is quite expensive.[5]

The peripheral nerve blockade with neurolytic agents and botulinum toxin are alternative treatment options to treat focal painful spasticity. They are proving very useful and are underused and undervalued.[3] Disadvantages of botulinum toxin include cost, need for repeat injections, and risk of developing antibodies.[6] Chemical neurolysis using phenol and alcohol is a cost-effective alternative to reduce spasticity, especially when it is confined predominantly to certain muscle groups.[7,8] The obturator nerve is neurolysed for management of hip adductor spasticity. Its efficacy in reducing skeletal muscle spasm has been reported in several studies.[9-14]

The approaches used to block obturator nerve include classic percutaneous approach, "3-in-1 block," and interadductor approach.[15-17] The nerve remains difficult to block using classic approach. In 3-in-1 block, the effect depends on the spread of anesthetic solution and is even more difficult in spastic patients with anatomical difficulties because to a variable degree, the lower limbs are crossed in front of each other. Thus, alternative approaches were described in order to improve its identification and success rate. Hence, the aim of our study was to evaluate a simplified and accurate approach (interadductor approach) to the obturator nerve with 6% phenol using nerve stimulation and also to assess prospectively its efficacy in the management of adductor muscle spasticity.

METHODS

The study was approved by institutional review board and ethical committee of our hospital. All patients gave informed consent. The patients were referred for evaluation and management of hip adductor spasticity. The cause and duration of spasticity was noted. Twenty patients were selected for obturator nerve block between May 2010 and December 2011 if spasticity resulted in impaired positioning in bed/wheelchair, interfered with activities of daily living, if perineal care and hygiene was compromised, and for ambulatory patients, if gait was interfered with. They continued to have their rehabilitation program depending on their medical condition. The patients with severe cardiac or respiratory problems, bleeding and coagulation disorders, inguinal lymphadenopathy, perineal infection, or hematoma at the needle insertion site were excluded from the study.

Before neurolytic application, a prognostic obturator nerve block was performed under the guidance of a peripheral nerve stimulator (Stimuplex, B. Braun). The needle used was sterile, 22-G, 100 mm/40 mm long, Teflon coated except at the bevel, so that a pulsed electrical stimulus was transmitted to the nerve only when it was in proximity of the bevel itself. The hub of the needle was connected to the stimulator that delivered a frequency of 1 Hz. The intensity of the current could be adjusted from 0 to 5 mA. The initial intensity of stimulation was kept at 1.5-2 mA.

The obturator nerve was blocked using interadductor approach. With the patient in a supine position, the surface landmark was located 1-2 cm medial to the femoral artery, immediately below the inguinal ligament. The adductor longus muscle tendon was identified at its pubic insertion and the needle was introduced behind it, directed laterally, and slightly posterior and superior toward the skin landmark until contractions of adductor longus and gracilis muscle were elicited. The adductor longus response of the obturator nerve was observed at the anterior part of entire inner thigh. Weak contractions of gracilis frequently accompanied, which formed a narrow muscular band down to the medial part of knee. Once the nerve was localized, the current intensity was reduced gradually up to 0.2-0.5 mA, needed to produce a contraction, suggesting that the bevel of the needle was close enough to the nerve. All nerve blocks were either performed by the senior author or were under supervision.

Initially 10 ml of 0.25% bupivacaine was used. Patient was allowed to assess its effect for 24 h. Neurolytic blockade was planned in the patients who had at least a 1° decrease in Modified Ashworth Scale (MAS) and a 20° improvement in range of motion (ROM). Obturator nerve blockade with 8-10 l of 6% phenol was performed the next day.

Technical evaluation included number of attempted needle insertions, time to accurate location of the nerve, depth of needle insertion, and success rate. Time to accurate nerve location was defined as the time elapsed after skin puncture to the end of nerve location. The depth of needle insertion was defined as the distance between the needle insertion point and final position of needle (skin to needle tip).

Functional evaluation before and after the neurolytic blockade included:

- Degree of muscle spasticity: Measured by MAS graded as 0-4.[18]
  - 0 = No increase in muscle tone
  - 1 = Slight increase in muscle tone, manifested by a catch and release or by minimal resistance at the end of the ROM when the part is moved in flexion or extension/abduction or adduction, etc
  - 1+ = Slight increase in muscle tone, manifested by a catch, followed by minimal resistance throughout the remainder (less than half) of the ROM
  - 2 = More marked increase in muscle tone through most of the ROM, but the affected part is easily moved
  - 3 = Considerable increase in muscle tone, passive movement is difficult
  - 4 = Affected part is rigid in flexion or extension (abduction or adduction, etc.)
- ROM of the hip abductors was assessed passively by the abduction of the hip joint and graded as 0-3.[12]
  0=Ability to abduct the thigh easily to 45°
  1=Ability to abduct the thigh to 45° with mild effort
  2=Ability to abduct the thigh to 45° with major effort
  3=Inability to abduct the thigh to 45°.

Both these parameters were measured with the patient supine and both knees extended.

- Pain: Severity was assessed on a 10-cm visual analog scale (VAS) where 0 represents no pain and 10 represents the worst possible pain.[19]
- Number of spasms experienced was recorded on spasm frequency scale.[20]
  0=No spasm
  1=One spasm or fewer per day
  2=Between one and five spasms per day
  3=Between five and nine spasms per day
  4=Ten or more spasms per day.
- Perineal hygiene: Assessed using a 4-point scale, considering the ability of the patient to perform perineal hygiene care, related to the degree of adductor muscle spasticity.
- Hygiene score (HS)[12]
  0=Hygienic performance with relative ease
  1=Hygienic performance with mild difficulty
  2=Hygienic performance with moderate difficulty
  3=Hygienic performance with severe difficulty
- Gait was assessed, in ambulatory patients, using a 4-point score, representing the effect of obturator neurolysis on spasms and leg crossing.[12]
  0=Patient able to walk with mild difficulty
  1=Patient able to walk with moderate difficulty
  2=Patient able to walk with severe difficulty
  3=Patient unable to walk.

All these parameters were reevaluated at the 1st hour, 24th hour, 1st week, and the 1st, 2nd, and 3rd months following the blockade. The patients were also evaluated for dysesthesia, injection pain, and skin injury, neuritis, or any other complication in the follow-up period.

At the end of the study, all the parameters were compiled and statistical analysis was done using SPSS for windows Version 18. The differences among repeated measurements were evaluated by the Friedman test. When the P value from Friedman's test statistics was statistically significant, the Bonferroni-adjusted Wilcoxon's sign-rank test was used to determine stepwise differences between the various time intervals. A $P < 0.05$ was considered statistically significant.

RESULTS

The clinical characteristics and distribution of diagnoses are shown in Table 1. Among the 20 patients in this study, there were 17 males and 3 females. The spasticity was due to spinal cord injury in 16 patients, Koch's spine in 2 patients, and multiple sclerosis in 2 patients. Mean duration from onset of neurological lesion to chemical neurolysis was 10.62±12.23 months (range 3-60 months). The technical parameters evaluated have been shown in Table 2. Changes in MAS, VAS, spasm frequency scale, ROM of hip abduction, hygiene score, and gait score between pretreatment values at 1st hour, 24th hour, 1st week, 1st, 2nd, and 3rd months are presented in Table 3.

The spasticity, ROM, and frequency of spasms improved at all time intervals from the baseline (P=0.000). Analysis between various time intervals revealed the values to be significant between 1st week and 3rd month (P=0.02 with MAS, 0.007 with ROM, and 0.006 with frequency

Table 1: Clinical characteristics of the patients with obturator nerve block

Mean age
36.7±9.8 years
Sex
17 males (85%)
3 females (15%)
Diagnosis
Spinal cord injury (*n*=16)
Koch's spine (*n*=2)
Multiple sclerosis (*n*=2)

of spasms). The MAS and spasm frequency values at 1st month were significant in comparison to 2nd and 3rd month values (P=0.005 and P=0.000, respectively) for both the parameters, while ROM values at 1st month were significant only from 3rd month values (P=0.000). Even there was significant difference between 2nd and 3rd month values (P=0.011 with MAS, 0.000 with ROM, and 0.002 with spasms), indicating the return of spasticity, but improvement was still significant from the baseline [Figures 1-3].

There was significant improvement in pain as evident by the VAS scores, with maximum decrease in the 1st week [Figure 4 and Table 3]. The maximum improvement in hygiene was noticed at 1st month, but no statistically significant difference was observed between 2nd and 3rd months, indicating the ability to perform hygiene to be persistent even at 3rd month. Functionally, only three subjects were ambulatory. There was improvement in the gait score after neurolysis, which was statistically significant at 1st week, 1st, 2nd, and 3rd months, when compared with baseline. There was no significance noticed between various time intervals, reflecting the effect to be persistent up to 3rd month. Inspection of gait after the injection revealed decreased scissoring of hips, improved balance and gait speed. All of them, however, still needed assistive devices for ambulation.

Table 2: Evaluation of the technical parameters (mean±SD)

Parameters	
Total number of blocks	30
Unilateral	10
Bilateral	10
Number of attempts for needle insertion	1.96±0.61
3rd attempt	5
2nd attempt	19
1st attempt	6
Minimum current at which contraction appeared	0.302±0.026 mA
Time to accurate location	4.9±2.06 min
Depth of needle insertion	2.91±0.32 cm
Success rate	100%

Only two patients (10%) developed dysesthesia. One patient developed it in the 1st week lasting for 10 days, while the other one developed it in 1st month persisting for 7 days. Only one patient developed fibrosis at the injection site after 20 days of injection. None of the patients developed neuritis or secondary deafferentation pain.

All the evaluated parameters have shown a dramatic improvement in spastic condition of the patients, which occurred immediately after the block and persisted till the follow-up. All except two patients were satisfied with the results of the neurolytic block at 3rd month. Nursing staff and caretakers acknowledged a facilitation of nursing care.

DISCUSSION

Traditional approaches to the obturator nerve are quite unsuitable in patients presenting with spastic conditions of the lower limbs, because of major difficulties in achieving adequate positioning. The classic approach involves the patient to lie supine with limb abducted, has high failure rate, and remains difficult even in expert hands, while 3-in-1 technique is associated with high failure rate due to the deep location of obturator nerve.[16,21,22] Our patients could not be placed in a suitable position, as opening the lower limbs was markedly difficult due to scissoring effect of adductor spasm.[23] Wassef described the interadductor approach to overcome these technical difficulties. The cutaneous and osseous landmarks are not essential for the accuracy of nerve location. It allows the tip of the needle to be placed easily in the obturator canal before division of the nerve.[17] In our study, the high success rate could be attributed to more accurate approach. This is comparable to the study by Viel *et al.* who also used the same approach, but in combination with fluoroscopy. This is in contrast with more traditional approaches, with a success rate of approximately 60% or less (Magora *et al.*) or 80% (Wassef), as they did not use a nerve stimulator or fluoroscopy.[17,21]

Spasticity is due to increased gamma motor activity. Chemical neurolytic agents like ethyl alcohol and phenol are options for decreasing localized spasticity. Ethyl alcohol in

Table 3: Outcome measurements during the follow-up period

Variables	Baseline	1st hour	24th hour	1st week	1st month	2nd month	3rd month
MAS	2.96±0.41	2.65±0.5$	2.06±0.43$	1.91±0.39$	1.8±0.67$	1.98±0.74$¥	2.11±0.71$♀¥Ω
VAS	7.03±2.61	3.3±2.11$	3.4±1.54$	2.13±1.38$	2.8±2.44$♀	3.3±2.56$♀¥	4.06±2.5$♀¥Ω
Spasm frequency scale	3.46±0.73	0.2±0.55$	2.06±0.94$	1.5±0.82$	1.4±1.22$	1.66±1.24$¥	2±1.17$♀¥Ω
Range of motion	2.83±0.37	2.7±0.53$	2.06±0.69$	1.83±0.53$	1.73±0.86$	1.76±0.81$	2.23±0.85$♀¥Ω
Hygiene score	2.43±0.62	2.16±0.59$	1.76±0.43$	1.43±0.56$	1.36±0.66$	1.53±0.68$¥	1.7±0.74$♀¥
Gait score	2.83±0.37	2.83±0.37	2.76±0.56	2.66±0.75$	2.66±0.75$	2.66±0.75$	2.7±0.70$

Data are expressed as mean ± SD, $ – The difference compared with the baseline was statistically significant (P<0.05); ♀ – The difference compared with the 1st week was statistically significant (P<0.05); ¥ – The difference compared with the 1st month was statistically significant (P<0.05); Ω – The difference compared with the 2nd month was statistically significant (P<0.05); MAS – Modified Ashworth scale; VAS – Visual analog scale

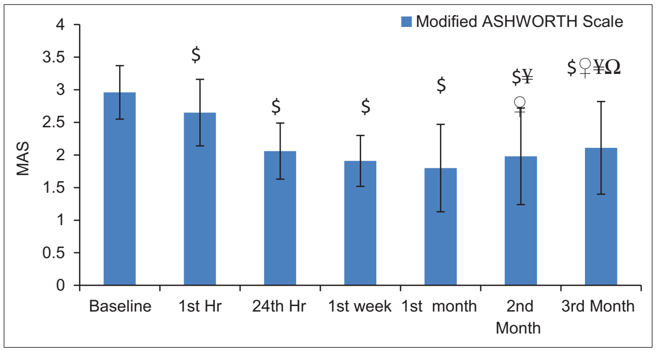

Figure 1: Evaluation of spasticity of hip adduction following phenol neurolysis of the obturator nerve. $ – The difference compared with the baseline was statistically significant ($P<0.05$); ♀ – the difference compared with the 1st week was statistically significant ($P<0.05$); ¥ – the difference compared with the 1st month was statistically significant ($P<0.05$); Ω – the difference compared with the 2nd month was statistically significant ($P<0.05$)

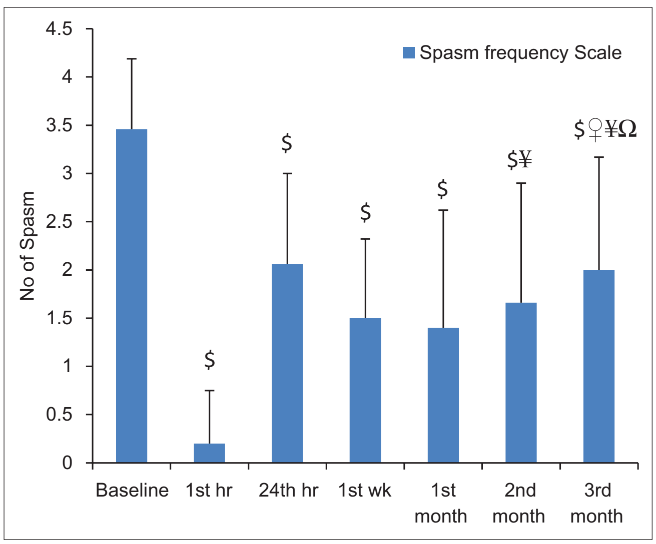

Figure 3: Evaluation of number of spasms following phenol neurolysis of the obturator nerve. $ – The difference compared with the baseline was statistically significant ($P<0.05$); ♀ – the difference compared with the 1st week was statistically significant ($P<0.05$); ¥ – the difference compared with the 1st month was statistically significant ($P<0.05$); Ω – the difference compared with the 2nd month was statistically significant ($P<0.05$)

higher concentration selectively denatures the proteins and injures cells by precipitating and dehydrating protoplasm. Disadvantages include skin irritation, permanent peripheral nerve palsy, and painful muscle necrosis.[24] Phenol is the major oxidized metabolite of benzene. It is a widely available drug which is inexpensive and has a wide margin of safety. It has an established place as a neurolytic agent. It exerts two actions on nerves. First, it has a short-term effect similar to local anesthetics, which is directly proportional to the thickness of the nerve fibers, and secondly, it has a long-term effect related to protein denaturation. Wallerian degeneration occurs approximately 2 weeks following the injection and eventually there is re-growth of most

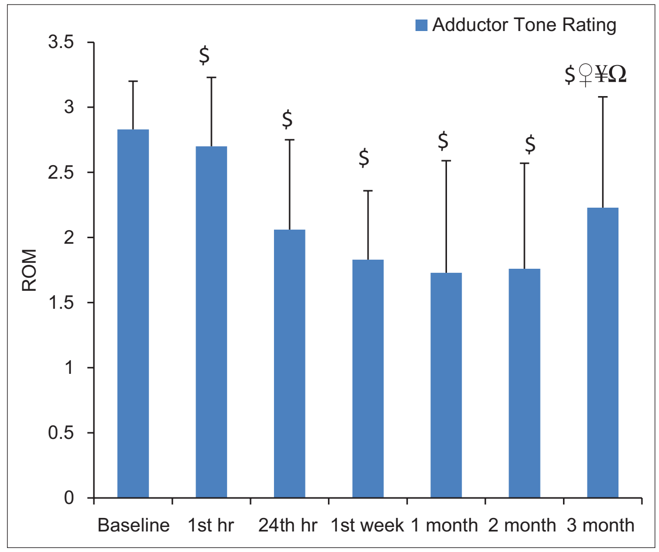

Figure 2: Evaluation of hip abduction following phenol neurolysis of the obturator nerve. $ – The difference compared with the baseline was statistically significant ($P<0.05$); ♀ – the difference compared with the 1st week was statistically significant ($P<0.05$); ¥ – the difference compared with the 1st month was statistically significant ($P<0.05$); Ω – the difference compared with the 2nd month was statistically significant ($P<0.05$)

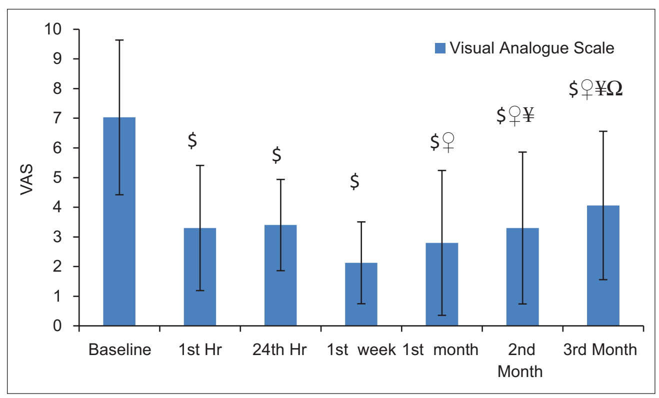

Figure 4: Evaluation of pain score following phenol neurolysis of the obturator nerve. $ – The difference compared with the baseline was statistically significant ($P<0.05$); ♀ – the difference compared with the 1st week was statistically significant ($P<0.05$); ¥ – the difference compared with the 1st month was statistically significant ($P<0.05$); Ω – the difference compared with the 2nd month was statistically significant ($P<0.05$)

of the axons by 14th week.[25,26] It improves the voluntary movement without sensory loss due to selective gamma motor inhibition.[27] Khalili pioneered the phenol nerve block and considered that the ideal management was quantitative and long-lasting alleviation of spasticity in a selected group of muscle fibers without impairment of sensation and voluntary movement or local/systemic side effects. He reported average beneficial effect lasting up to 308 days (range 2-743 days).[7] A significant improvement was found in the clinical findings of the present study, which lasted until the 3rd month, when some parameters began to approach the initial values. Spasticity was relieved without clinical evidence of sensory impairment except in cases with complications. As spasticity decreased, there was definite improvement of ROM of hip joint.

Viel *et al.* performed obturator neurolysis with 65% ethanol in 23 patients with persistent spasticity. They reported time to accurate nerve location as 13,030 s, which is in contrast to 4.9±2.06 min in our study. It could be explained by more number of attempts in our study. They also observed that adductor spasm, triple flexion scores, gait, and hygiene scores improved significantly from baseline. These parameters were stable for 4 months.[12] They did not study the effect on pain, which significantly improved in our study. The decreased spasticity of the adductor muscles produced less stretch on the joint capsule, decreasing tension on it, and thereby decreasing pain. Another potentially important factor was that the head of the femur may impinge on the periosteum of the acetabulum; following obturator block, there was decreased spasticity and adductor pull, decreasing excursion of the head of the femur against the periosteum.[28]

Akkaya *et al.* used 5-10 ml of 6% phenol under the guidance of fluoroscopy and peripheral nerve stimulator in 62 patients and reported improvement in VAS, Ashworth Scale (AS), ROM, and HS at the 1st week and the 1st, 2nd, and 3rd months.[14] We used MAS to assess the degree of spasticity which is a more reliable indicator than AS. The efficacy on frequency of spasms and gait was additionally reported in our study. They reported statistically significant difference on spasticity of hip adductors between the 1st week and 1st month, which is in contrast to our study. The effect on ROM was persistent in our study till the end of 2nd month and had worn off in their study. The functional improvement in our study outlived the duration of relief of spasticity as evident by increased ROM which persisted longer than adductor spasm. This could be explained as due to intensive physiotherapy after the relief of spasticity. The increased hip abduction range led to the suppression of a significant source of strain and discomfort, and thus helped the patients in positioning, maintaining proper perineal hygiene, and in self-care activities like toileting and lower half dressing. It also helped in transferring and proper ambulation by decreasing the scissoring of the gait. The need for daily stretching, splinting, and bracing was diminished. Functional rehabilitation of the neurological patients helped conversion from a bedridden or chair-bound status to an improved ability to walk with the help of calipers as was seen in three patients in our study.

In a study by Gunduz *et al.* on 36 spastic patients using 2-3 ml of 5% phenol, the neurolysis findings regressed through the end of 2nd month.[11] The difference could be explained by the less volume of phenol used. Trainer *et al.* reported clinical recovery after 6 weeks with 6% phenol.[28] Kumar *et al.* in a study on 20 patients using 6% phenol reported improvement in the parameters up to 21 days. In addition, they evaluated the cost of antispastic medications, which was a limitation in our study.[13] Kong and Chua used 100% ethyl alcohol in 13 subjects and found the effect to be persistent even up to 6 months and 18 months in six cases.[10] In contrast, Yadav *et al.* reported an average period of effectiveness to be 13 months (range 3-18 months) with 6% phenol in 115 cases of cerebral palsy.[9] None of the studies have evaluated the effect of obturator neurolysis over spasm frequency in the internal rotators of hip, which decreased significantly in our study. The spasms disturb the function of sitting at early stages of rehabilitation and walking.

Repeated injections of phenol had no effect when the initial spasticity was severe and when it returned less than 2 months after the first block. They were useful in some moderate cases, giving similar results to those achieved after the first injection.[29] This was evident by repeated blocks required in three patients in our study. One patient had it repeated at 3rd month, while in the other two patients, the effect had worn off after 20 days and even repeated injections did not provide them complete relief. Intrathecal alcohol (0.5 ml) was given in one of these patients as he had flexion deformity and contractures of both the lower limbs. Kandikattu *et al.* observed an improvement in spasticity and reduction in pain after application of phenol intrathecally.[30] But intrathecal usage is more invasive. Further clinical studies should be planned to compare the efficacy of both the techniques.

The common complication of phenol blocks is dysesthesia.[31] It was reported in two patients in our study. Phenol has a blocking power on smaller gamma fibers due to easier diffusion, rather than large alpha motor fibers. But it can also have some effect on the sensory axons of the treated nerve.[2] Fibrosis was explained due to phenol damaging the surrounding tissues. Phenol injected into a vessel can cause thrombosis, ischemia, and tissue sloughing. An overdose can cause tremors, central nervous system depression, and cardiovascular collapse.

Important limitation of our study is the lack of a control group. The use of ultrasound can further enhance the success rate and reduce the volume of neurolytic solution as it is placed in closed vicinity of the nerve. It can also shorten the time to block the nerve. Further controlled clinical trials are required to assess the efficacy of ultrasound-guided neurolytic blockade procedures, which have been accepted as a reliable guide in regional anesthesia in recent years.[32]

To conclude, interadductor approach is a safe, effective, and accurate approach to obturator nerve to relieve spasticity. Obturator neurolysis provides excellent cost benefit relation and high margin of safety with rare complications, especially when administered by well-qualified professionals. Although an old technique, it provides a better quality of life for patients by reducing adductor spasm and maximizes functional benefits of the rehabilitation program.

ACKNOWLEDGMENT

We would like to thank Dr. S. S. Sangwan, Vice-Chancellor of University of Health Sciences, for his support in carrying out this study.

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How to cite this article: Ghai A, Sangwan SS, Hooda S, Garg N, Kundu ZS, Gupta T. Evaluation of interadductor approach in neurolytic blockade of obturator nerve in spastic patients. Saudi J Anaesth 2013;7:420-6.

Source of Support: Nil, **Conflict of Interest:** None declared.