Outcomes following Neuromuscular Blockade using Phenol for the Treatment of Spasticity among Children with Cerebral Palsy: A Descriptive Cross-sectional Study

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Introduction: The effectiveness of phenol injection in treating patients with cerebral palsy is not clearly understood. This study aims to find out the outcomes following neuromuscular blockade using phenol for the treatment of spasticity among children with cerebral palsy.

Methods: A descriptive cross-sectional study was conducted between January 1, 2006, and June 30, 2007, at HRDC, Banepa, Nepal (ethical approval number: B&BIRC-23-06) among children with cerebral palsy. Children who had history of prior chemo-neurolysis therapy, in whom the treatment could not be instituted, who required additional method of treatment, and who did not provide consent, were excluded. The outcomes were measured at 1-day, 1-month, 3-month, and 6-month. Outcomes were measured using adduction spasticity angle, popliteus angle, equinus contracture, Modified Ashworth Scale for Spasticity scores and prevalence of complications. Continuous data were reported as mean (range) and categorical data will be reported as number (percentage).

Results: A total of 50 patients were included. Out of which, 36 (72%) were male and 14 (28%) were female. The average age of the patient was 5.8 years (range, 2 to 14 years). Average Modified Ashworth Scale improved from 2.6, 2.5, and 2.8 to 1, 1, and 1.3, in adductors, hamstrings, and gastrocnemius, respectively at 6-month. Average adductor spasticity angle, popliteus angle, and eqinus contracture measurements were improved from 7.2˚, 52.5˚, and 14.38˚ to 6.0˚, 23.33˚, and 9.16˚ at 6-month.

Conclusion: Phenol injection is safe and effective in treating patients with spastic cerebral palsy resulting in improvement in Modified Ashworth Scale, popliteus angle, and equinus contracture.

Keywords: *cerebral palsy; Modified Ashworth Scale; phenol injection; popliteus angle*

Spasticity is common manifestation in children with cerebral palsy (CP), which results in significant functional disability.[1] Literature suggests that early institution of treatment may improve clinical outcomes drastically.[1,2] Several treatment options, such as physiotherapy, extracorporeal shock wave therapy, laser acupuncture, surgical release, and chemo-neurolysis, have been described.[3–6] Out of which, chemo-neurolysis has been found to be more effective and botulinum toxin-A or Phenol are commonly preferred agents.[6]

Botulinum Toxin-A injection is found to be safe, effective, and superior to Phenol injection for neuromuscular blockade in treating spasticity associated with CP.[7,8] However, it is costly, and usage may not be feasible in resource poor settings.[9] Popularity of phenol block has decreased over the years because several unwanted events have been reported. [10,11] However, it is cheap, and some studies have found comparable efficacy and safety compared to botulinum toxin-A injection.[12,13] Despite this, the effectiveness in terms of functional scores and deformity improvements are not clearly understood. Hence, this study aims to find out the outcomes following neuromuscular blockade using phenol for the treatment of spasticity among children with CP.

Methodology

A descriptive cross-sectional study was conducted between January 1, 2006, and June 30, 2007, at Hospital and Rehabilitation Centre for Disabled Children (HRDC), Banepa, Kavre, Nepal following the approval from Institutional Review Committee (IRC) of B&B Hospital and HRDC (reference number: B&BIRC-23-06) among children with CP. All children with CP undergoing treatment for spasticity using phenol injection were included in the study. Children who had history of prior chemo-neurolysis therapy, in whom treatment could not be instituted, who required additional method of treatment, such as surgical release, and whose guardian refused to be included in the study, were excluded. Convenient sampling method was used.

Data were recorded in a pro forma. The age, gender, and types of CP were recorded. All included patients underwent phenol injection as following: The motor

Grade	Description
0	No increase in muscle tone
1	Slight increase in tone giving a catch when slight increase in muscle tone, manifested by the limb was moved in flexion or extension
1+	Slight increase in muscle tone, manifested by a catch followed by minimal resistance throughout
2	More marked increase in tone but more marked increased in muscle tone through most limb easily flexed
3	Considerable increase in tone, passive movement difficult
4	Limb rigid in flexion or extension

Table 1: Modified Ashworth Scale for Spasticity

point was identified with a surface stimulator in a standard Medelec electromyograph with a pulse duration of 0-1 ms, and then the point of maximum electrical sensitivity was identified in the depths of the muscle. The hypodermic needles were used as the cathode and were connected to the stimulator. The anode was connected to a dispersive electrode placed behind the limb. The current was increased to 10 mA and the tip of the needle was slowly advanced in the direction of the motor point. Contractions in the spastic muscles were seen. After preliminary aspiration a small quantity, usually 1-2 ml, of an aqueous solution of phenol 5% is injected. The immediate effects were the abolition of contractions and a reduction in the degree of spasticity.[10]

All patients were followed up for 6 months following injection. The outcomes were measured at 1-day, 1-month, 3-month, and 6-month. Efficacy outcomes were measured using adduction spasticity angle, popliteus angle, equinus contracture, and Modified Ashworth Scale for Spasticity scores (as shown in **Table 1**).[14] Safety outcomes were measure using prevalence of complications.

Descriptive statistics were used. Continuous data were reported as mean (range) and categorical data will be reported as number (percentage).

Results

A total of 50 patients were included. Out of which, 36 (72%) were male and 14 (18%) were female. The average age of the patient was 5.8 years (range, 2 to 14 years). Out of 50, 36 (72%) were spastic diplegia, 9 (18%) were spastic hemiplegia, 1 (2%) were spastic quadriplegia, and 4 (8%) were others. The efficacy outcomes were shown in **Table 2 and 3**.

Location	Pre-injection	1-day	1-month	3-month	6-month
Adductors	2.6	2.0	1.7	1.5	1
Hamstring	2.5	2	1.5	1.5	1
Gastrocnemius	2.8	2	1.5	1.5	1.3

Table 2: Average Modified Ashworth Scale for spasticity in different locations (n=50)

Parameters	Pre-injection	1-day	1-month	3-month	6-month
Adductor spasticity angle	7.5	7.0	6.25	6.25	6.0
Popliteus angle	52.5	27.5	26.0	25.0	23.33
Equinus contracture- knee extended	14.38	7.5	8.7	8.7	9.16

Table 3: Average adductor spasticity angle, popliteus angle and eqinus contracture measurements (in degrees) (n=50)

Out of 50 patients, generalized flaccidity was observed in 1(2%) case, which was improved within 3 months and sore injection site was observed in 2(4%) cases, which were managed conservatively.

Discussion

This study identified that the average Modified Ashworth Scale for spasticity improved gradually following the phenol injection from around 2.5 to around 1 overtime in all three motor points, including adductors, hamstrings, and gastrocnemius over the period of 6 months. This suggests that there was improvement of around 1.5 points over 6 months. It is known from the literature that minimal clinically important difference (MCID) for Modified Ashworth Scale for spasticity was around 0.45-0.73 for lower extremity muscles.[15] Similar improvement was reported by Gonnade et al.[13] in a comparative study in which they compared the outcomes of phenol injection with Botulinum Toxin-A injection. Although the outcomes with Botulinum Toxin-A injection were superior to phenol injection, phenol injection groups also demonstrated clinically important improvement in Modified Ashworth Scale. The difference in Modified Ashworth Scale among phenol injection group at 6 months from pre-injection level was around 0.36-0.6, which was lower compared to our study, which was 1.5 points. This could be due to the difference in pre-injection status of children with CP, which was 2.7-3.3 in Gonnade et al.[13] study whereas 2.5-2.8 in our study. This suggests that phenol injection is effective in providing

satisfactory clinical improvements in patients with CP.

This study also identified that adductor spasticity angle improved by around 1.5 degrees, popliteus angle was improved by around 30 degrees, and equinus contracture was improved by 5 degrees (in knee extension), gradually over the period of 6 months. The outcomes were similar to what reported in previous study.[5] A study conducted by Khot et al.[5] including 16 children found that the improvements in popliteus angle was around 31 degrees and equinus deformity improved by around 9 degrees. Although adductor spasticity angle was not evaluated, Khot et al.[5] found that hip abduction improved by around 33 degrees at 6 months. This suggests that phenol injection improved clinical parameters at 6 months post-injection. However, there was gradual decline in the clinical outcomes after 6 months. At 24-month, the improvement in popliteus angle and equinus contracture was 2 degrees and 6 degrees, respectively.[5] This suggests that phenol injection may not provide long-term clinical benefits. Thus, long-term analysis is needed to further clarify the long-term clinical benefits of phenol injection.

Increased risks of complications, including acute flaccid paralysis, was the main reason for declining popularity of phenol injection therapy.[11] However, in this study, only 2% developed acute flaccid paralysis, which was improved within 3 months. Some previous studies have found that phenol injection is safe and associated with minor adverse events which were reversible.[12,13] Polypetch et al.[12], in a retrospective study involving 98 children with CP, found that combined Botulinum Toxin-A and 5% phenol injection resulted in 21% unwanted events, all of which were minor weaknesses. Similarly, Gonnade et al.[13] found no difference in complication in between groups receiving Botulinum Toxin-A and 5% phenol injection. Furthermore, Wong et al.[7], in a comparative study including 16 patients in Botulinum Toxin-A group and 11 patients in 5% phenol injection group found that the complications in 5% phenol injection group were more severe that Botulinum Toxin-A group. However, there was considerable variation in sample size and the most common complications were calf pain and hyperesthesia which were resolved within 1 month. This suggests that phenol injection may result in some minor complications, which can be resolved by supportive therapy and serious complications are rare.

This study has several limitations. This was a single center cross-sectional study which might have significant risk of selection and reporting bias, and there might be decreased external validity. A

long-term clinical benefit of phenol injection is not clear, as the follow-up duration was of 6 months. Effect of phenol injection on gross motor function was not evaluated. However, a sample size of 50 is reasonable compared to contemporary literature and considering the rarity of the condition.

Conclusion

Phenol injection is safe and effective in treating patients with spastic CP resulting in improvement in Modified Ashworth Scale, popliteus angle, and equinus contracture. However, there is a risk of developing acute flaccid paralysis. In addition, future research should evaluate gross motor function following phenol injection therapy.

Conflict of Interest: None

References

1. Crenna P. Spasticity and "spastic" gait in children with cerebral palsy. Neurosci Biobehav Rev. 1998;22:571–8.
2. Ayala L, Winter S, Byrne R, Fehlings D, Gehred A, Letzkus L, et al. Assessments and Interventions for Spasticity in Infants With or at High Risk for Cerebral Palsy: A Systematic Review. Pediatr Neurol. 2021;118:72–90.
3. Lin Y, Wang G, Wang B. Rehabilitation treatment of spastic cerebral palsy with radial extracorporeal shock wave therapy and rehabilitation therapy. Medicine (Baltimore). 2018;97:e13828.
4. Putri DE, Srilestari A, Abdurrohim K, Mangunatmadja I, Wahyuni LK. The Effect of Laser Acupuncture on Spasticity in Children with Spastic Cerebral Palsy. J Acupunct Meridian Stud. 2020;13:152–6.
5. Khot A, Sloan S, Desai S, Harvey A, Wolfe R, Graham HK. Adductor release and chemodenervation in children with cerebral palsy: a pilot study in 16 children. J Child Orthop. 2008;2:293–9.
6. Tilton AH. Injectable neuromuscular blockade in the treatment of spasticity and movement disorders. J Child Neurol. 2003;18 Suppl 1:S50-66.
7. Wong AMK, Chen C-L, Chen CPC, Chou S-W, Chung C-Y, Chen MJL. Clinical effects of botulinum toxin A and phenol block on gait in children with cerebral palsy. Am J Phys Med Rehabil. 2004;83:284–91.
8. Kim H, Kolaski K. Is botulinum toxin type A more effective and safer than other treatments for the management of

lower limb spasticity in children with cerebral palsy? A Cochrane Review summary with commentary. NeuroRehabilitation. 2021;49:161–4.

9. Kazarian GS, Van Heest AE, Goldfarb CA, Wall LB. Cost Comparison of Botulinum Toxin Injections Versus Surgical Treatment in Pediatric Patients With Cerebral Palsy: A Markov Model. J Hand Surg Am. 2021 May;46:359–67.
10. Copp EP, Harris R, Keenan J. Peripheral nerve block and motor point block with phenol in the management of spasticity. Proc R Soc Med. 1970;63:937–8.
11. Nash TP. Acute paraplegia following intrathecal phenol block. Vol. 49, Anaesthesia. England; 1994;p.1011–2.
12. Ploypetch T, Kwon J-Y, Armstrong HF, Kim H. A Retrospective Review of Unintended Effects After Single-Event Multi-Level Chemoneurolysis With Botulinum Toxin-A and Phenol in Children With Cerebral Palsy. PM R. 2015;7:1073–80.
13. Gonnade N, Lokhande V, Ajij M, Gaur A, Shukla K. Phenol Versus Botulinum Toxin A Injection in Ambulatory Cerebral Palsy Spastic Diplegia: A Comparative Study. J Pediatr Neurosci. 2017;12:338–43.
14. Bohannon RW, Smith MB. Interrater reliability of a modified Ashworth scale of muscle spasticity. Phys Ther. 1987;67:206–7.
15. Chen C-L, Chen C-Y, Chen H-C, Wu C-Y, Lin K-C, Hsieh Y-W, et al. Responsiveness and minimal clinically important difference of Modified Ashworth Scale in patients with stroke. Eur J Phys Rehabil Med. 2019;55:754–60.