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CRYOTHERAPY: A NON-SURGICAL MANAGEMENT OPTION FOR SEVERE, MEDICALLY REFRACTORY SPASMS AFTER SPINAL CORD INJURY: TWO CASE REPORTS

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ABSTRACT

Introduction: Neuromodulation in its various forms is emerging as a promising method of dealing with chronic pain and movement disorders. The scale of ablative vs augmentative procedures seems to be tilting towards augmentative procedures. We observed 8 patients who had failed medical treatment for muscle spasm respond to the cold application.

Case summary: We report 2 cases of complete traumatic spinal cord injury patients, who developed severe, medically intractable muscle spasms. We applied cryotherapy to their legs with significant improvement.

Outcome measurements: The spasm frequency score dropped immediately from a 4 to 0 in one patient. The other dropped from a 2 to 1 on day one then disappeared by day 7. Spasm severity dropped significantly on the first day in both cases.

Conclusion: Cryotherapy as a form of neuromodulation, Is an effective, simple but safe way to symptomatically manage severe medically refractory muscle spasms in spinal cord injured patients. It becomes an important adjunct in the management of these patients in resource-limited settings where surgical options are not readily available.

Keywords: cold therapy, cryotherapy, spasms, spasticity, neuromodulation, and spinal injury.

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INTRODUCTION

Cryotherapy is the application of cold on body parts to facilitate treatment. It involves the use of cold sprays, ice packs as well as cold water application, in a bid to lower the skin temperature and therefore decreases neuronal cellular activity and the blood flow in tissue [4]. Clinical trials have shown that cryotherapy has analgesic effects and reduces local edema; this treatment is, therefore, an option in patients with painful and inflammatory conditions [5]. Its use in pain management and its safety is well established [6]. The use of cold therapy in spasticity has been tried, but not many studies have been done or documented [7]. A study has been done on the use of cold therapy on the management of severe clonus with impressive results [8]. The use of cryotherapy specifically for spasms has not been widely tried and to the author's knowledge, no case reports or trials have been documented on the use of cryotherapy to manage severe refractory muscle spasms in spinal cord injured patients. Hence we report on our experience with such cases.

Spasms are defined as involuntary muscle contractions. They are usually associated with spasticity which is involuntary muscle stiffness, both of which occur as part of a group of signs for an upper motor neuron lesion together with clonus and hyperreflexia [9]. Spasticity can complicate the activities of daily living of patients affected [10].-

- Pathophysiology of spasticity and spasms is poorly understood but appears to be related to an increased excitatory state at the segmental spinal level. There is no evidence for increased sensitivity of muscle spindles in spastic patients. Several mechanisms for this increased excitability within the spinal cord have been proposed [2,9]. It is believed to be caused by a reduction in spinal neuronal inhibition mechanisms, associated with descending pathways or with specific segmental modulatory circuits in addition to changes in the intrinsic motor-neuron and passive muscle properties. Physiotherapy is the first treatment option and plays an important role in the management of this neuropathology [4].

Case summary: 1

Patient information: A 46-year-old man presented with a backache and failure to feel or mobilize his lower limbs after a mining accident. He was in a mine working underground when a huge rock fell on his back and he heard a cracking sound in his back and he immediately fell to the ground and could no longer feel his legs. He noticed he could no longer move his lower limbs. He lost control of his bowel and bladder function. He, however, did not loose consciousness. He was carried to the Emergency Department.

Physical Examination: He was fully conscious. He had a blood pressure of 126/87, the pulse was 74 beats per minute, respiration rate of 16 breaths per minute and apyrexial. He had a sensory level at T12 with no sensation below that. He had no power in all the muscle groups of the lower limbs. The tone was reduced and there were no reflexes in the lower limbs except for the bulbocavernosus reflex. Cranial nerve exam and neurological exam of the upper limbs was normal. He had a gibbus deformity around the 10th thoracic vertebra with associated skin abrasions in that area. The rest of the systems examinations were normal.

Diagnosis and assessment: Imaging done revealed a burst fracture of the tenth thoracic vertebrae. He had a complete spinal cord injury. Initial management was as per spinal injury protocol in the unit. He was managed conservatively on bed rest and thoracolumbar corset and gradually intensifying rehabilitation.

On the 10th week during rehabilitation, he developed severe muscle spasms of the lower limbs that were hindering his progress with physiotherapy to the extent that he could not use the wheelchair. He was commenced on baclofen 15mg per day. The dose was gradually increased every third day to the maximum of 120mg/ day in divided doses with not much change to the spasms. Diazepam was then added to the regimen and increased to 40mg per day until the sedation and drowsiness were disabling.

Intervention: At this point, cold application therapy was introduced. He would dip his lower limbs up to the knee level in cold water with ice packs for 20 minutes once daily. The temperature of the water was around 10 degrees Celsius. There was marked, immediate reduction in the severity and frequency of the spasms as shown in table 1. No adverse effects were noted within 2 months of follow up.

Case summary: 2

Patient information: A 35-year-old man presented with a severe backache and failure to feel or mobilize his lower limbs after a motor vehicle crash. He was a passenger in the back seat of a sedan car that was speeding and failed to negotiate a curve resulting in it overturning several times. The patient was unrestrained and was thrown out of the vehicle landing on a hard surface on his back. He lost consciousness for a brief period. On regaining consciousness at the accident scene, he noticed he could no longer feel his body from the chest downwards and could not move his lower limbs. He was carried by well-wishers to the hospital without any spinal protection.

Physical Examination: On arrival to the hospital he was fully conscious. He had a blood pressure of 147/92, the pulse was 68 beats per minute, respirations were shallow with a rate of 19 breaths per minute and he was in marked pain. He was apyrexial. He had a sensory level at T10, with a positive Beevor's sign. He had no power in all the muscle groups of the lower limbs. The tone was reduced and there were no reflexes in the lower limbs except for the bulbocavernosus reflex. He had no sacral sparing. Cranial nerve exam and neurological exam of the upper limbs was normal. He had a gibbus deformity around the 8th thoracic vertebra with associated skin abrasions in that area. He also had multiple abrasions on his upper limbs and trunk, including the back. The rest of the systems examinations were normal.

Diagnosis and assessment: Imaging done revealed a fracture dislocation at the seventh and eighth thoracic vertebrae, with a complete spinal cord injury. Initial management was as per spinal injury protocol in the unit. He was managed conservatively (after declining surgery for spinal fixation) on bed rest and thoracolumbar corset and gradually intensifying rehabilitation. By the time he was referred for rehabilitation he had developed bilateral trochanteric pressure sores for which he was being nursed.

Around the 8th week during rehabilitation, he developed severe muscle spasms of the lower limbs that were hindering his progress with physiotherapy to the extent that he could no longer use the wheelchair. He was commenced on baclofen 15mg per day. The dose was gradually increased every third day until response. However, after a while, he was no longer responding despite increasing the dose to the maximum of 120mg/day in divided doses. Addition of diazepam did not help.

Intervention: At this point, cold application therapy was introduced. Treatment was as of first patient above. His improvement was equally dramatic and no side effects noted at 2 months follow up.

This treatment with cold water was offered to a total of 8 patients who developed severe muscle spasms (which were not responsive to medical therapy with baclofen and diazepam oral) after traumatic complete paraplegia with similar results, however, we report in detail these two cases.

OUTCOME MEASUREMENTS

	Case 1			Case 2		
Scale	Day 0	Day 1	Day 7	Day 0	Day 1	Day 7
Spasm frequency	4	0	0	2	1	0
Spasm severity	3	-	-	2	1	-
Interference with function	2	-	-	1	0	-
Pain	1	-	-	0	0	-
Ashworth score	3	3	3	3	3	3

Table 1: *Table showing various scores for the two patients. Day 0 is the state just before starting cryotherapy, day 1 being 24hrs later, and day 7 is seven days later. See appendix 1 for grading scales*

DISCUSSION

Both patients despite reaching their maximum tolerable doses of baclofen and diazepam were still experiencing severe lower limb muscle spasms, which were now affecting their functionality. The second patient developed tolerance to baclofen which has been noted in the literature [11]. Baclofen was effective in reducing spasticity in 70-87% of patients in some studies. The same studies also showed a 75-96 % reduction in spasm. Tizanidine has also been shown to have the same efficacy albeit reduced side effects [3].

The remaining 4-20% who do not respond to baclofen are usually put on intrathecal baclofen and eventually surgery should they remain unresponsive [3]. This was unavailable for our patients due to resource constraints. Epidural spinal cord stimulation systems implanted have been shown to work for spasms unresponsive to medical therapy without any adverse effects noted. However, its use has not been compared with intrathecal baclofen [12]. Botulinum toxin A, [13,14] penile vibration, [15] intrathecal phenol and glycerine in metrizamide [16] have also been used effectively for the management of the disabling effects of severe spasms and spasticity within reasonable confines of tolerability. Selective Intrathecal phenol block was used with minimal reduction of spasticity and spasms without much adverse effects in one trial [17]. For medically refractory cases, percutaneous lumbar rhizotomy [1] can be offered, but selective posterior rhizotomy is the procedure of choice with long-term spasm reduction in 80% and also reduction in spasticity and improvement in bladder function in a few. The general tendency in the management of severe medically refractory spasm was to go on to intrathecal methods as well as surgery.

However less invasive and easily available methods such as cryotherapy may also be tried [8]. In our patients the results with cryotherapy were immediate and unlike for baclofen, the effects would last for longer, close to 24hrs. When used on a daily basis the effects seemed to last even longer.

The mechanism of action of cryotherapy in spasms may be explained in several ways. Temperature has been known to affect biological and neurophysiologic processes [19]. A study conducted on 45 females aged between 18 and 25 showed that the conduction velocity across the median nerve increased in a predictable fashion as the temperature was increased from 27 degrees to 37 degrees [19]. Low temperatures slow sodium channel opening which also delays its inactivation which probably explains the slowing of nerve conduction and the increase in amplitude [20]. The decrease in temperature causes a consequential reduction in sodium permeability of nerve axons during the excitation, this results in a slower influx of sodium and slower neural conduction. The resistance to conduction of impulse is increased by a decrease in temperature, this, in turn, increases the latencies and decreases the conduction velocity [19]. Fibrillations disappear, and muscle contraction is slower and weaker. Neuromuscular transmission improves [19,20].

An alternative explanation is the gate theory. It is interesting to note that some treatment modalities for chronic pain such as rhizotomy have worked well for muscle spasms [1,14]. This makes it easier to extrapolate some treatment modalities effective for chronic pain eg cryotherapy (to "kill" problematic neuromas) to be used for spasticity as well albeit in a slightly different manner. In the same vein some theories to explain how these treatment modalities work may also be the same. Gate theory is the foundation on which neuromodulation was birthed. Perhaps in the same way that flooding neuronal transmission with warm or cold sensation may cause the central nervous system to "muffle/ignore" aberrant painful nerve action potentials,

so can cold application cause the "muffling" of aberrant nerve firing causing spasms [21]. What would be difficult to explain however is the fact that these patients did not have sensation in the lower limbs, or rather (put more precisely) they lacked cerebral perception of sensory impulses.

CONCLUSION

Cryotherapy seems to be an effective modality of treatment for severe spasms refractory to medical therapy. Since it is readily available and relatively safe it may be the modality of choice for treating muscle spasms in spinal cord injury patients particularly in resource-limited centers. However, more studies need to be done to quantify its effectiveness, as well as determine the optimum temperatures and duration of the cryotherapy and to make comparisons between single modality and combination with medical treatment.

Authors declare no conflict of interest.

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Appendix-1[8,18]

SPASM FREQUENCY SCALE
0 No spasm
1 Spasms induced only by stimulation
Infrequent spontaneous spasms occurring less than one per hour
3 Spontaneous spasms occurring more than one per hour
4 Spontaneous spasms occurring more than 10 per hour

SPASM SEVERITY
1 Mild
2 Moderate
3 Severe

INTERFERENCE WITH FUNCTION
0 Does not interfere with function
1 Makes function difficult
2 Prevents function

PAINFUL SPASMS
0 causes no pain or discomfort
1 causes moderate pain or discomfort
2 causes severe pain or discomfort

ASHWORTH SCORE
0 No increase in tone
1 Slight increase in tone giving catch when the limb is moved in flexion or extension
2 More marked increase in tone but limb is easily flexed
3 Considerable increase in tone, passive movement is difficult
4 Limb rigid in flexion or extension