Treatment of Chronic Low Back Pain by Local Injection of Botulinum Toxin-A

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Citation

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Abstract

From 1998 to 2000, nineteen patients with chronic low back pain were studied by the Pain Magement Service. Diagnoses included myoneural syndrome and lumbosacral radiculitis. Ten patients were untreated (control) and nine were treated with local injection of Botulinum Toxin Type A (Botox®) into the paravertebral muscles of the low back. For all patients, measurements included visual analog pain score, McGill pain score, Oswestry & Roland-Morris disability score, spasm score and the range of lumbar spine motion. For controls, measurements were done at referral, during the first office visit, and after 1-12 months while awaiting treatment. For the treatment group, measurements were done at referral, during the first office visit, and following treatment. Our preliminary results demonstrated that: 1) During the time of referral, the control patients progressed (9/10 reported worsening of their pain); 2) With BTA treatment, the scores improved in the McGill scores (7/9), Oswestry & Roland-Morris disability scores (5/9), range of lumbar motion (4/9) and muscle spasm scores (>0.5 in 7/9) compared to the control group ($p < 0.05$).

Work done in the Pain Management Center, Department of Anesthesiology, LSUHSC Shreveport

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INTRODUCTION

Chronic low back pain affects millions of people and is the most common cause of disability in younger workers [1]. Muscle spasm is an important component of this pain. Therapies to decrease this spasm include medications, physical therapy, transcutaneous electrical nerve stimulation (TENS), biofeedback, and relaxation therapy.

Botulinum Toxin Type A (Botox®) in low doses produces a chemical denervation of muscles [2]. Since its use in the treatment of strabismus 20 years ago [3], Botulinum Toxin Type A has been effective in reducing muscle spasm in patients with cervical dystonia [4,5,6], achalasia and rectal fissure [7], chronic limb spasticity [8], blepharospasm [9], hand dystonia [10, 11], myofascial pain syndrome [12], fibromyalgia and Stiff-Person Syndrome [13], and numerous neurologic disorders [14].

Use of BTA in the treatment of chronic low back pain has been limited, and very few reports have been published on this subject [15, 16]. The present authors studied the effect of BTA in patients with low back pain secondary to lumbar muscle spasm and lumbosacral radiculitis.

MATERIALS AND METHODS

From 1998 to 2000, nineteen patients diagnosed with lumbar musclel spasm and/or lumbosacral radiculitis were followed for 6-12 months in our Pain Management Service at LSUHSC Shreveport. Before the first clinic visit, a series of questionnaires were presented: visual analogue pain scale, McGill-Melzack Pain Questionnaire [17], and Oswestry & Roland-Morris Disability questionaire [18]. Patients provided these data upon referral, at the first office visit, and then either within 1-12 months of referral (waiting list as control group), and after treatment (Botox® group). During their clinic visits, along with the questionnaires, the range of motion and muscle spasm scores were also measured by the investigators.

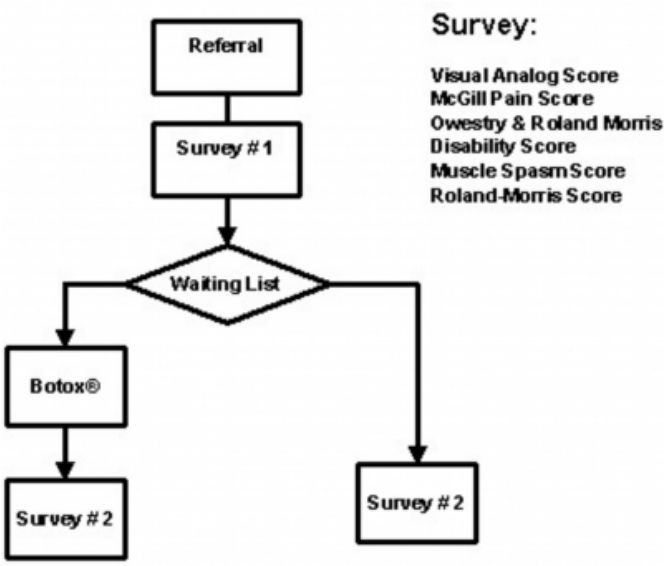
Nine patients were treated with local injections of Botox® (Allergan Pharmaceuticals (Ireland) Ltd. ,a subsidiary of: Allergan, Inc., 2525 Dupont Dr., Irvine, CA 92612) .

Fig 1 shows the study design. Botox® preparation was as follows: Each vial contained 100 units of Botox®, and 0.5 mg of albumin without preservative. One unit (U)

corresponds to the calculated median lethal intraperitoneal dose (LD50) in mice. The preparation was diluted to 8 ml with normal saline, and 2 ml (representing about 12 U of Botox® was injected into each site. Injections were into eight sites (4 on each side) into the erector spinae muscles, 2 cm lateral to the spinous process, between L2 and L5 (Fig 2). Patients were observed in the clinic for 30 minutes before discharge.

Figure 1

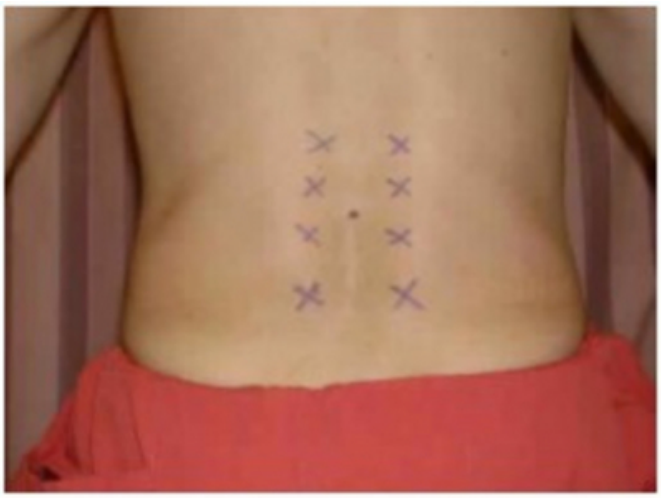
Fig 1. Study Design



Follow-up data was obtained during office visits at 1-12 months for controls, and at 1 and 6 months after treatment for the treated group. Data were analyzed by repeated-measures ANOVA, and significance was defined at <0.05.

Figure 2

Fig 2 Treatment Method



Local injection sites at levels L2-5. Each site was injected with 2 ml of solution with 12.5 units of Botox® into the paraspinous muscles about 2 to 2.5 cm lateral to spinous processes. Total injection was 100 units.

RESULTS

Table 1 summarizes the results. Mean age of the control and treatment groups was 49.5 7.0and 50.6 7.0. There were 3 males and 7 females in the control group, and 4 and 5 in the treatment group. There was no significant difference in age and sex between groups. All of them were diagnosed as lumbar muscle spasm and/ or lumbosacral radiculitis (control 0/10, BTA 4/9).

Figure 3

Table 1

Groups	Control	BTA
Numbers of patients	10	9
Age (Mean ± SEM)	49.5 ± 7.0	50.6 ± 7.0
Sex	3 M/ 7 F	4 M/ 5 F
Diagnosis		
Muscle Spasm	10/10	9/9
Lumbar Radiculitis	0/10	4/9 (overlap)
McGill – Melzack Scores		
Improved	0/10	7/9*
No changed	4/10	2/9
Worsened	6/10	0/9
Oswestry Scores		
Missed work and Disabled	5/10	1/9
Improved	1/10	5/9
Range of Motion Scores		
Limited	7/10	1/9
Improved	0/10	4/9
Muscle Spasm Scores		
Improved (>0.5)	0/10	7/9*

* ANOVA one-way test, P <0.05

In the control group, patients experienced progressively worse pain and stiffness as measured by their McGill pain scales, visual pain scales, (6/10 worsened), as well as worsened Oswestry & Roland-Morris scores (6/10 missed work and disabled).

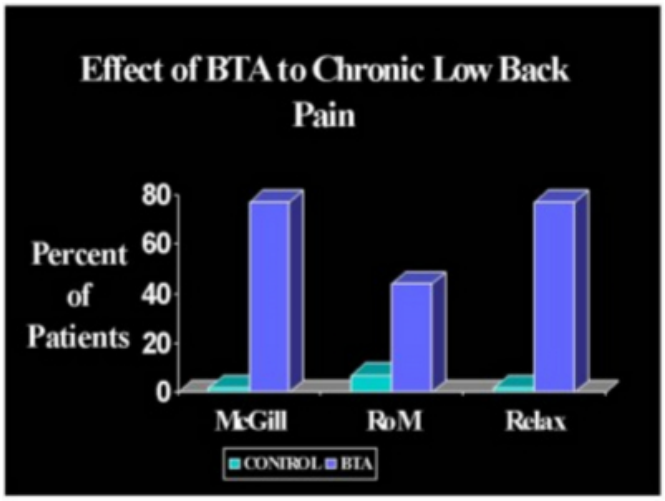
In the treatment (Botox®) group, all patients had immediate relief from spasm and pain following injections. At 1 and 6 months following treatment, for the McGill pain scores, 7/9 had improved, 2/9 showed no change, and none were worse. For the Oswestry & Roland Morris disability scores, 5/9 had improved and went back to work, Botox®2/9 were unchanged, but none were worse. For the range of motion, 4/9 improved, one still had limited motion, and the rest had no change. None of the Botox® patients suffered complications such as sedation, systemic muscle relaxation, infection, hemorrhage or severe pain during and following

injection.

In the treatment (Botox®)group, seven of nine patients reported significant relief of back pain, while in the control (untreated) group, none reported relief ($P < 0.05$, ANOVA, table 1). Fig 3 summarizes these results.

Figure 4

Fig 3 Summary of Results



Percent of patients indicated number of patients improving for each test

McGill = McGill Pain Score
ROM = Range of Motion Score
Relax = Muscle Spasm Score
BTA – Botulinum Toxin A (Botox®)

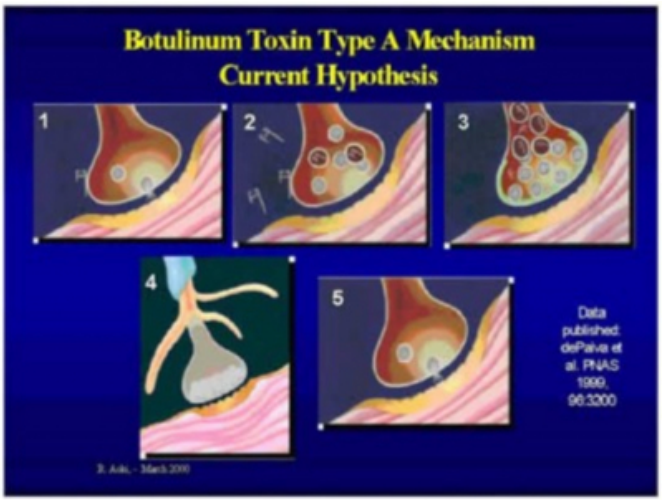
DISCUSSION

Most low back pain from muscle strain is a self-limited process with approximately 90% of patients recovering within two months [19]. For the remaining patients, chronic pain may result. Mechanical low back pain may result from overuse of normal muscles (muscle strain), injury or deformity of an anatomic structure (herniated nucleus pulposus), osteoarthritis, spinal stenosis, spondylolisthesis, or scoliosis [19]. This pain is associated with back strain and may be related to muscles that are tonically contracted in the resting position. Muscle contractions may also begin as a protective response to an acute injury. This increased muscle tension reduces back movement and allows the damaged area to heal, usually in an abnormal position. Reduced blood flow to muscles in spasm allows accumulation of metabolic byproducts that may stimulate pain receptors in blood vessels. If muscle tension is sustained, it can establish a pain-spasm-pain cycle, leading to chronic pain [20]. Our data showed that the control group became progressively worse. This is consistent with the muscle pain-spasm-pain cycle. Therefore, reducing muscle spasm may interfere with this cycle and relieve this chronic pain.

Botulinum Toxin Type A prevents the release of acetylcholine by the presynaptic axon at the motor endplates of cholinergic neurons [2]. (Figure 4). It has been used therapeutically to produce a partial chemical denervation by injecting minute doses directly into the motor endplate region of the muscle.

Figure 5

Figure 4 Hypothesis of BOTOX Mechanism



Photograph donated by Allergan Laboratories

At the nerve terminal, botulinum toxin type A is thought to induce a temporary chemodenervation through the following steps:

1. The toxin binds to acceptors (yet to be identified) on cholinergic terminals.
2. The molecule is internalized into the nerve ending.
3. Once inside the nerve ending, botulinum toxin interferes with the exocytosis of cholinergic vesicles. This leads to chemodenervation and reduced muscular contractions.
4. Over time, terminal sprouting occurs.
5. Finally, the original functional endplate is re-established and sprouts regress (as reported by Prof. Oliver Dolly's laboratory). At this point symptoms may return in some patients.

Botulinum Toxin Type A, a 150 KDs protein, binds irreversibly to presynaptic cholinergic nerve terminals (Fig 4, 1), and once internalized Fig 4,2), blocks exocytosis of the neurotransmitter acetylcholine (fig 4, 3). Therefore muscle contraction is inhibited. This toxin, from the bacteria Clostridia Botulinum, is the most potent known biological toxin and may be responsible for life-threatening paralysis [21, 22]. Skeletal muscle is chemically denervated, remaining paralyzed until the nerve supplying the motor end-plate sprouts new axons and forms new synaptic contacts (Fig 4, 4), reestablishing the neuromuscular junction (Fig 4, 5) [23, 24].

Injection of Botox® directly into the target muscles could have the advantage of reducing muscle spasm without producing sedation. This is in contrast to systemic muscle relaxants. Studies by others indicate it may also be of benefit in the treatment of muscle spasm associated with chronic low back pain [15, 16] .

Botox® may produce a prolonged reduction of spasm by producing a partial, reversible denervation of the muscles. Selective weakening of painful muscles in spasm may interrupt the pain-spasm-pain cycle, and facilitate rehabilitation.

CONCLUSIONS

In this preliminary study, patients injected with Botox® demonstrated improvement in range of motion and pain scores, compared to untreated controls. No sedation or muscle weakness was noted. This represents a significant addition to the tools available to the pain management physician for the treatment of low back pain.

ACKNOWLEDGEMENTS

Photograph donated by Allergan Laboratories

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