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Research Article

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Role of Botulinum Toxin in Post-Stroke Spasticity Related Shoulder Pain

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Abstract

Shoulder pain is a very common complication after stroke, with a reported prevalence varying from 23% to 64%. There are very few treatment options that have been shown to be more effective than placebo for relief of post-stroke shoulder pain. One of the factors most frequently associated with shoulder pain is spasticity, especially when the muscles are stretched.

Botulinum toxin A (BT-A) is one of the treatments available for the treatment of focal spasticity and its effectiveness in reducing upper limb spasticity in stroke is well documented.

In this review, patients with shoulder pain and spasticity after hemiplegia, a single injection of BT-A was associated with a statistically significantly greater reduction in shoulder pain on a numerical rating scale (NRS) from 6/10 at initial assessment; to 1/10 two months post injection. Nine patients (56%) were pain free at 5 and 9 months post-injection.

Median Modified Ashworth Scale (MAS) scores for shoulder spasticity in the affected upper limb improved from 3 at the initial assessment to 2, two months post injection and remained as 1^+, five and nine months post injection.

There was also a significant improvement in median passive shoulder abduction range of motion on the affected upper limb from 80 degrees at the initial assessment to 95 degrees, two months post injection and further improvement to 110 degrees in 9 patients, 5 months post injection.

BT-A seems to be effective in managing post- stroke shoulder pain secondary to spasticity.

Keywords: Botulinum Toxin, BT-A, Post-Stroke Spasticity, Shoulder Pain

Introduction

Shoulder pain is a common and disabling complication after stroke, with a reported prevalence varying from 23% to 64%. It can interfere with the rehabilitation process and may also decrease performance of activities of daily living. It is associated with a reduction in quality of life. There are very few treatment options that have been shown to be more effective than placebo for relief of post-stroke shoulder pain.

One of the factors most frequently associated with shoulder pain is spasticity. Spasticity causes muscles to be shortened and may result in pain, especially when the muscles are stretched. Muscle shortening and pain also adversely affect movement and joint range of motion. This focal spasticity can also lead to restricted use of the arm, interfering with activities of daily living such as dressing, showering and hygiene maintenance. It can also lead to development of pressure areas. Reduction of spasticity can lead to alleviation of shoulder pain, improved joint range of motion and can help achieve activities of daily living with lesser carer and patient burden.

BT-A is one of the treatments available for the treatment of focal spasticity and its effectiveness in reducing upper limb spasticity in stroke is well documented. A Cochrane review by Singh et al. compared the efficacy and safety of BT-A in comparison to placebo or other treatment options for post-stroke shoulder pain [1]. Randomized controlled trials (RCTs) comparing BT-A with placebo or active treatment in people with shoulder pain were included. Six RCTs with 164 patients were included. In five studies of patients with spasticity after stroke or hemiplegia, BT-A was injected intramuscularly into various muscles including pectoralis major, infraspinatus, and subscapularis [2-5]. These studies found that intramuscular injection of botulinum toxin type a significantly reduced post-stroke shoulder pain at 3-6 months.

To our knowledge, there have been no studies conducted to date to assess the efficacy of BT-A injections into anterior deltoid muscle for the treatment of shoulder pain due to post-stroke spasticity. Pectoralis major and anterior deltoid muscles were chosen as

they are both easy to localise and inject, with associated no safety concerns. Teres major and rhomboid major were the additional muscles injected in this study. Infraspinatus and subscapularis muscles are additional muscles that have been injected in other studies, but as these muscles are difficult to localise, even with the ultrasound guidance, we elected not to inject these muscle groups.

Methods

A retrospective file audit was performed on stroke patients treated at the Royal Prince Alfred Hospital spasticity clinic over a 3 year period, with shoulder pain and impaired function due to shoulder spasticity. A total of 16 patients were studied who had received a single course of BT-A injected into pectoralis major, anterior deltoid, teres major and rhomboid major muscles of the affected shoulder.

Patients with persistent shoulder pain (grade ≥ 5/10 on Numerical Pain Scale) at least 3 months post stroke with spasticity in shoulder muscles were included in the study.

Patients with spasticity due to other neurological causes like Multiple Sclerosis, Motor Neurone Disease, neuromuscular disease (Myasthenia Gravis), traumatic brain injury, spinal injury, pregnancy and lactation, patients receiving aminoglycoside antibiotics such as gentamicin therapy or receiving intrathecal baclofen were excluded. Patients who had fixed contractures of the shoulder (Modified Ashworth Scale grade 4) or allergic reactions/ hypersensitivity to BT-A were also excluded.

Outcome measurements were performed at baseline, 2 months, 5 months and 9 months post intervention.

Primary outcome measure

a) Pain on Numerical Rating Scale (NRS)

Secondary outcome measures

b) Spasticity on Modified Ashworth Scale (MAS)

c) Passive Range of Motion (PROM: shoulder abduction)

Results

A total of 16 patients were studied, of which 69% were male. The average age of the patients was 65 and the average time from stroke to initial assessment was 8.5 months. 69% of patients had ischaemic stroke and 31% of patients had haemorrhagic stroke.

The median spasticity on the Modified Ashworth Scale (MAS) pre-injection was 3 at the shoulder, 2 at the elbow, 2 at the wrist and 2 at the fingers.

- 8 patients (50%) took adjuvant medications to try to improve spasticity. 5 patients were taking baclofen, 1 on dantrolene, 1 on gabapentin and 1 was taking clonazepam.
- 3 patients had shoulder steroid injections prior to BT-A and 1 patient had shoulder rotator cuff repair and capsular release prior to BT-A.

All 16 patients (100%) received BT-A (Dysport) injection into pectoralis major, 63% of patients (10 patients) received BT-A injection into teres major, 50% of the patients (8 patients) received BT-A injection into anterior deltoid, 44% of patients (7 patients) received BT-A injection into rhomboid major. The average BT-A (Dysport) injected in the affected shoulder muscle groups was 200 units into pectoralis major, 200 units into anterior deltoid, 100 units into teres major and 125 units into rhomboid major (Figure 1).

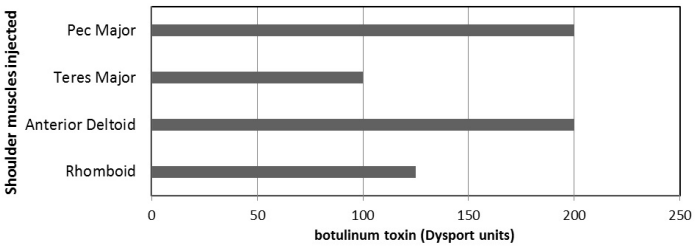

Figure 1: The muscles injected and median botulinum toxin (Dysport units) injected.

All patients received therapy interventions post BT-A, including splinting, stretching and Functional Electrical Stimulation (FES), through a number of services. 31% of patients received occupational therapy services through stroke outreach, 12% of patients received day hospital occupational therapy services, 25% of patients received outpatient physiotherapy services, 13% of patients received inpatient rehabilitation, 13% of patients received physiotherapy in the nursing home and 6% of patients received services through an aged care package. The changes in spasticity, shoulder pain and passive shoulder abduction with time are shown in (Figure 2).

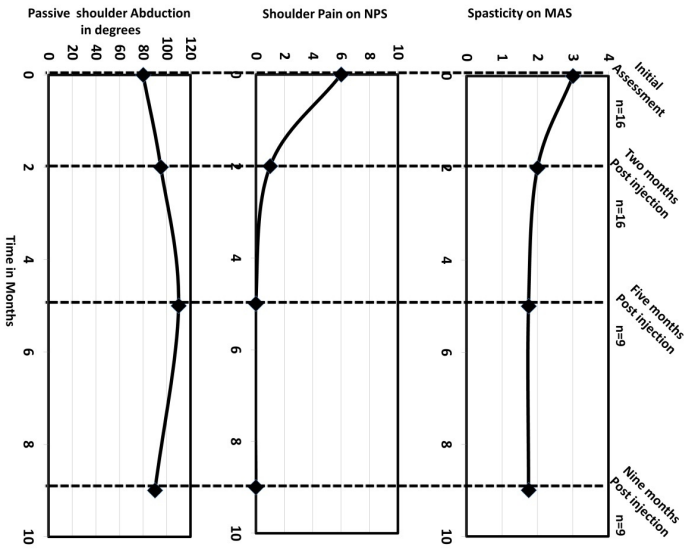

Figure 2: Spasticity, shoulder pain and passive shoulder abduction changes.

Median modified Ashworth scale (MAS) of the shoulder improved from 3 on the affected upper limb to 2, two months post injection and remained at 1+, five and nine months post injection.

Median shoulder pain on Numerical Pain Scale (NPS) on the affected upper limb was 6/10 at the initial assessment and reduced

to 1/10 on NPS, two months post injection. Nine patients (56%) were pain free at 5 and 9 months post-injection. This reduction of pain resulted in significant functional gains, including improved upper limb dressing speed, typing, holding objects and ease hygiene.

Median passive shoulder abduction range of motion in the affected upper limb was 80 degrees at the initial assessment. This improved to 95 degrees, two months post injection and further improved to 110 degrees in 9 patients, 5 months post injection. 9 months post injection the passive shoulder abduction range of motion was 90 degrees in these 9 patients.

Case study

47 year old male presented with left shoulder pain, 8 months post stroke. He had good hand function, but limited shoulder range of motion of his left shoulder and shoulder pain. He was referred to a Rheumatologist and was diagnosed with adhesive capsulitis. He had a sub-acromial steroid injection without benefit and was referred to the spasticity clinic.

Despite normal upper limb power, he had MAS grade 3 shoulder spasticity, which was preventing optimal hand positioning, overhead activities, swimming, and his goal of resuming push-ups and chin-ups. He had left shoulder pain of 10/10 on NPS and reduced PROM of 80 degrees in abduction, 10 degrees in external rotation.

He had an excellent response to BT-A injections into his left pectoralis major, left anterior deltoid, left teres major and left rhomboid major. This resulted in a significant improvement in his left shoulder pain from 10/10 to 3/10 on NRS 2 months post injection. Left shoulder spasticity improved from 3 to 2 on MAS. PROM of the left shoulder improved from 80 degrees of abduction to 110 degrees of abduction and 10 degrees of external rotation to 60 degrees of external rotation 2 months post injection.

He was pain free 5, 9 and 18 months post injection with improvement of PROM abduction to 180 degrees. As a result, functionally he was able to achieve all his goals.

Discussion

Shoulder pain secondary to spasticity is a very common and troublesome complication after stroke resulting in a reduction in quality of life. Randomized controlled trials have compared intramuscular injection of BT-A with placebo in the treatment of post stroke shoulder pain and found there is a statistically significant greater reduction in pain severity at 3-6 months compared to placebo. In these studies, BT-A was injected intramuscularly into various muscles including pectoralis major, infraspinatus, and subscapularis.

Spasticity commonly involves pectoralis major, which is responsible for flexion, adduction and internal rotation of the shoulder and anterior deltoid, which is involved in abduction, flexion and internal rotation of the shoulder. Spasticity of these muscles is associated with post-stroke shoulder pain. Pectoralis major and anterior deltoid muscles were chosen as they are both easy to localise and inject. There are no safety issues when injecting these muscles, from our own experience and from previous studies.

Teres major is involved in adduction, internal rotation and extension of the shoulder. Rhomboid major retracts and elevates medial border of the scapula and subscapular internally rotates the shoulder.

Infraspinatus and subscapularis muscles are additional muscles that have been injected in other studies, but as these muscles are difficult to localise, even with the ultrasound guidance and therefore were not injected in this study.

To our knowledge there have been no studies conducted to date to assess the efficacy of BT-A injection to the anterior deltoid muscle for the treatment of shoulder pain due to post-stroke spasticity. We found that patients responded well after BT-A injection into anterior deltoid, pectoralis major, teres major and rhomboid major. BT-A injections were effective in managing post- stroke shoulder pain secondary to spasticity.

A randomized controlled trial with a larger sample size is underway to review the outcome of BT-A in the management post- stroke shoulder pain secondary to spasticity.

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