The Boon in a Toxin: Injection Botulinum Toxin for Spasticity Management in Children with Cerebral Palsy

Chasanal Rathod

Spasticity in children with neuromuscular disorders can be treated with oral medications, chemodenervation with Phenol, Ethanol, or Botulinum toxin (BTX) injections and surgical procedures like Intrathecal baclofen and Selective Dorsal Rhizotomy [1]. BTX injection or Botox* is known for its wide use in cosmetic surgery. However, it is used in much larger doses and frequency in kids with spasticity. Before the advent of BTX, chemodenervation was performed with Phenol (Carbolic acid) which caused denaturation of proteins, precipitation and dehydration of protoplasm, its use discontinued as it was not FDA approved and it caused nerve damage and muscle necrosis and the most important effect was not reversible. Next widely used for spasticity control was Ethanol (45–100%) and it also came along with a set of irreversible damage to muscles causing atrophy, dysesthesias (permanent weakness), scarring, and granuloma formation [1, 2, 3]. At present, the most widely used and worldwide accepted and FDA approved is BTX which is a toxin derived from Clostridium Botulinum, a Gram-negative bacillus (Bacteria), there are various serotypes(A, B, C1, D, E, F, and G) the most common one used is A. At present, Inj BTX -A is available with different brand names as shown in Fig. 1. Each of this has specific dosing, is not interchangeable, and has approved indications. Extensive clinical data exist for only two Type A preparations for children in CP, that is, Botox and Dysport [1-4].

Mechanism of Action: BTX-A binds with the Motor nerve terminal. BTX-A blocks the release of Acetylcholine (Ach), a neurotransmitter from axon endings. This chemical denervation causes a temporary reduced muscular activity in the injected muscles. The site of injection is near the motor end plate [1,2,3,4]

Indications for BTX-A injection: (a) Spastic muscle causing limitation of movement, (b) spasticity more than Ashworth Gr 2., (c) progression of spasticity, (d) to avoid contractures during growth spurt, And (e) to enable near normal gait pattern. For Upper extremity: (a) To improve the function, (b) better Grasp and release, (c) to achieve functional position of upper extremity[4,5].

Optimum age and dosage for BTA-A injection: The optimal timing is reported between 2 and 6 years (Fig. 2). The dose depends on units/kg body weight which differs for each muscle (Table 1). The safe recommended total dosage in one sitting is up to 400 u for Botox and 500–1000 for disport [1,4].

For a good outcome, an integrated approach is required (Fig. 3). The appropriate muscle selection is based on the spasticity, selective motor control of the muscle, detailed evaluation by the neurophysiotherapist. A complete contraindication would be a contracture of the muscle. Outcome measures as well as evaluation by Shriner’s hospital Upper extremitiy evaluation and 3D gait analysis provides a more accurate information prior and post the BTX-A injection. Common muscles injected are: Lower Extremity: Gastrocnemius, Medial Hamstrings, Tibialis posterior, Rectus femoris, and Iliopsoas. Upper extremity: Pronator Teres, Flexor carpi ulnaris, Brachialis, Adductor Pollicis, and Finger Flexors.

Technique: Various Techniques are: Free Hand technique (Fig. 4), Stimulator Guided (Fig. 5), and Ultrasound Guided (Fig. 6). The muscles are injected near the motor end plates which cause effective outcome. The anatomical landmarks for each muscle for the free hand technique or stimulator-guided technique are identified around the maximum girth of the muscle belly. For the free hand technique, the needles are inserted and check for the synchronous movements along with the adjacent joint. The stimulator-guided technique is for upper extremity muscles, deep muscles-tibial posterior as free hand would not be reliable here. The preferred technique is USG guided as it is the most accurate and safe technique, can target small and deep muscles without repositioning the

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needle, less time consuming, and gives a real time visualization of the distribution of the BTX-A injection. The injection is equivalent to an intramuscular injection and can be safely performed with sedation if needed. Only in cases when the spasticity varies for different muscle and the dosage for surgery involves inj BTX_A and soft-tissue lengthening then would require an operative theater [1, 6, 7].

Adverse effects reported are mild pain at injection site, bruising, and influenza such as symptoms. It should be used cautiously in children with pre-existing bulbar symptoms, gastroesophageal reflux, and frequent chest infections. Contraindications are Myasthenia gravis, Eaton Lambert syndrome, concomitant use of aminoglycoside, or non-depolarizing muscle relaxant [3].

Post-injection protocol: Usually the effect of Inj BTX-A is seen within 48 h after the injection and peaked between 1 and 3 weeks [3]. The injection is combined with casting, orthotic management, and intensive rehabilitation [5]. Various studies in the literature have established good outcomes post-injection, improvement in gait patterns, and prevention of deformities/contractures. The maximum the effect lasts up to a year and newer recommendation is to repeat the

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**Table 1:** Dosage of BTX-A for various muscle.

<table>
<thead>
<tr>
<th>Muscle Injected</th>
<th>Dose range</th>
<th>Number of sites</th>
</tr>
</thead>
<tbody>
<tr>
<td>Biceps</td>
<td>2</td>
<td>2-3</td>
</tr>
<tr>
<td>Pronator teres</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Flexor carpi radialis</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>Flexor carpi ulnaris</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>Flexor digitorum superficialis</td>
<td>2</td>
<td>1-2</td>
</tr>
<tr>
<td>Flexor digitorum Profundus</td>
<td>2</td>
<td>1-2</td>
</tr>
<tr>
<td>Flexor pollicis longus</td>
<td>0.5-1</td>
<td>1</td>
</tr>
<tr>
<td>Adductor Pollicis</td>
<td>0.5-1</td>
<td>1</td>
</tr>
</tbody>
</table>

In general maximum of 50U/site

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**Figure 1:** BTX-A injections brands available.

- Onobotulinumtoxin A – Botox
- Abobotulinumtoxin A – Dysport
- Incobotulinumtoxin A – Xeomin

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**Figure 2:** Timing of Inj BTX-A and other interventions for a CP child.

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**Figure 3:** The integrated approach of Inj BTX-A for a good outcome.
injection after a year if needed [1, 3, 5, 8-10]. Injection BTX-A is effective for spasticity control, selectively, with almost nil
complications. Its safe for younger children, reversible, does not cause weakness, and gives desired good outcomes.

**Declaration of patient consent:** The authors certify that they have obtained all appropriate patient consent forms. In the form, the patient has/her given his/her consent for his/her images and other clinical information to be reported in the Journal. The patient understands that his/her name and initials will not be published, and due efforts will be made to conceal his identity, but anonymity cannot be guaranteed.

**Conflict of Interest:** NIL; **Source of Support:** NIL

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**References**


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