Abstract: Botulinum toxin type A (BTX-A) has been shown to be a safe and effective treatment for focal or segmental muscle overactivity, including spasticity. Local injections of BTX-A are particularly valuable in relieving focal spasticity around a joint or a series of joints. When integrated into an overall spasticity treatment plan with clearly outlined functional goals, BTX-A may offer significant benefits to the appropriately selected adult or pediatric patient. A range of clinical outcome measures are used to evaluate the patient prior to injection. Initial dosing guidelines are offered, though each patient may have a unique drug response profile and set of modifying factors that will be used as a basis for dose adjustments. Clinical benefit usually lasts for approximately 12 weeks, though in some patients the duration of effect may be longer. Assessment of the patient's clinical and functional status is performed at each follow-up appointment, and the contribution of BTX therapy to the goals of the patient and caregiver are evaluated. Other therapeutic options should be considered where appropriate, and the treatment plan revised when necessary. Guidelines for dilution, handling, and office procedure are offered. ©1997 John Wiley & Sons, Inc.

Keywords: botulinum toxin, dosing, administration, treatment algorithm

Dosing, Administration, and a Treatment Algorithm for Use of Botulinum Toxin A for Adult-Onset Spasticity

Mitchell F. Brin, MD, and the Spasticity Study Group

Rationale

Botulinum toxin type A (BTX-A) is an effective treatment for focal or segmental muscle overactivity. It can be administered safely and with relative ease to nearly any muscle affected by spasticity. The resulting reduction in tone is long-lasting but reversible, and the dose can be adjusted based on clinical observation and patient reports. More than a decade of clinical experience has shown BTX-A to be a versatile tool for decreasing abnormal muscle tone in a wide range of disorders. BTX-A has been effectively used to treat spasticity from the upper motor neuron syndrome in both adults and children (see Table 1). The decision to use BTX-A is independent of the etiology of the spasticity, depending rather on the presence of a frank increase in muscle tone that interferes with function.

The reasons for treating spasticity are diverse, encompassing functional improvement, increased comfort or ease of care, promotion of physical or occupational therapy programs, and postponement or obviation of need for more aggressive interventions (see Table 2). BTX-A can offer significant benefits to the appropriately selected patient. The efficacy of both physical and occupational therapy programs may be enhanced following BTX treatment, and increased ease of hygiene, transfers, positioning, mobility, and caregiving are all potentially realistic goals. For patients receiving intrathecal baclofen for global tone reduction, BTX-A can provide more focal spasticity relief. BTX-A may also alleviate the pain associated with muscle spasms, tonic muscle contraction, or increased tone. The complete mechanism of action for pain relief is not well understood, and whether BTX-A affects mechanoreceptors or chemoreceptors has not been fully elucidated. Although so far unproven in clinical trials, but suggested by animal studies, it is generally accepted that prompt intervention in the spasticity process may prevent long-term complications. For this reason, early and aggressive physical and occupational therapy, combined with local injection of BTX, may be an ideal strategy for the treatment of spasticity while it is still evolving.

Tone reduction may not, however, be a therapeutic goal in and of itself, and BTX use must be part of an overall treatment plan, with clearly outlined functional goals uppermost. The patient who is “using his spasticity” to meet functional challenges may not benefit from spasticity reduction. In most situations, the management program includes compensatory training as part of the BTX treatment regimen. Neither is BTX an appropriate therapy to treat contracture.

KEY POINTS

- The decision to use BTX-A is independent of the etiology of the spasticity, depending rather on the presence of an increase in muscle tone that interferes with function.
- Early and aggressive physical and occupational therapy, combined with local injection of BTX, may be an ideal strategy for the treatment of spasticity while it is still evolving.
per se, although within a fixed contracture, there may be residual dynamically contracting muscle that can be weakened.

Finally, BTX-A is only one of a host of possible therapies for spasticity now available. These treatments are discussed by Gracies\textsuperscript{9,10} and Chambers\textsuperscript{6} elsewhere in this syllabus, and are briefly summarized here:

Oral pharmacotherapy may provide some global tone reduction in patients with spasticity. Dose-limiting side effects may preclude adequate relief, and serum may need to be monitored for adverse reactions.\textsuperscript{9,10} If an acceptable dose is identified, follow-up visits can be minimized, reducing expense for monitoring and maintenance.

Intrathecal baclofen affords a general reduction in tone especially in the lower extremities.\textsuperscript{2,5} This may be appropriate in select individuals with brain or spinal cord lesions; however, the intrathecal delivery system requires an increased level of monitoring and maintenance, and has the potential for significant complications. In many patients, intrathecal baclofen provides a global background of tone reduction in which BTX-A injections provide focal relief.

Phenol or alcohol neurolysis may provide inexpensive, longer-term denervation. However, the duration of effect may vary widely, and the neurolysis may lead to pain, especially when mixed nerves are treated.\textsuperscript{9} Nonetheless, for many patients these forms of chemodenervation are appropriate and effective.

Surgical intervention in the central nervous system is typically restricted to patients who have either not benefitted from more conservative interventions, or for whom no other intervention is appropriate. Currently, the most widely accepted procedure is selective dorsal rhizotomy.\textsuperscript{9} Tenotomy and serial casting to correct contractures may be appropriate when range of motion exercises cannot prevent their development or worsening. Alternative therapies, such as acupuncture\textsuperscript{24} or biofeedback,\textsuperscript{18} while not widely tested, may provide some relief in selected patients.

**Patient Selection and Evaluation**

An algorithm for treatment with botulinum toxin is presented in Figure 1 and reproduced within this syllabus as a wall chart. At the first meeting of the patient and clinical team, the patient is evaluated for presence of the upper motor neuron (UMN) syndrome and resulting muscle overactivity. Once confirmed, the clinical team determines if a controlled reduction in tone is practical. This alone, however, is not enough to justify treatment with BTX-A. The appropriateness of any spasticity treatment depends on its ability to meet the goals of the patient and caregiver, whether for improved function, comfort, care, or cosmesis, or reduction of complications from spasticity. The clinical team works together with the patient and caregiver to clarify these goals, develop an overall spasticity management plan, and determine the role of BTX-A treatment within this plan. If muscle overactivity is present, may practically be reduced by BTX-A, and its reduction has the potential to meet the defined objec-

---

**Table 1. Spastic Disorders for Which Botulinum Toxin May Be an Appropriate Therapy**

<table>
<thead>
<tr>
<th>Cerebral Palsy</th>
<th>Spinal Cord Injury</th>
</tr>
</thead>
<tbody>
<tr>
<td>Stroke</td>
<td>Multiple Sclerosis</td>
</tr>
<tr>
<td>Brain Injury</td>
<td>Neurodegenerative Disease</td>
</tr>
</tbody>
</table>

---

---

---

---
Within these broad guidelines, several points may be emphasized:

1. Spasticity may be focal, multifocal, or generalized. Local injections of BTX-A are particularly valuable in relieving focal spasticity around a joint or a series of joints. In most clinical situations, an acceptable dose may be administered into muscles around one or two joints per treatment session. Therefore, when planning treatment, muscle selection is crucial. However, although BTX-A is a focal treatment, it may improve function in untreated muscles as well, by interfering with the synergy patterns that often replace isolated muscle control in the patient with spasticity. When treating one muscle, adjacent or neighboring muscles may also have a reduction in tone.3

2. Muscles chosen for injection must be those in which controlled weakness will not interfere with current patient function. For instance, in the hemiplegic arm in which there is no voluntary control, a prompt and profound decrease in muscle tone rarely imposes additional disability on the patient. In a patient with demyelinating disease with some residual strength, a graded weakness with a lower dose of BTX may be the appropriate strategy. Similarly, complete weakness of the thigh adductors or gastrosoleus may be completely acceptable in a nonambulatory patient, while in the ambulatory patient, a mild tone reduction is more likely to pre-

### Table 2.
**Possible Goals of Botulinum Toxin Therapy in the Management of Spasticity**

<table>
<thead>
<tr>
<th><strong>Improved Function</strong></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Mobility (ambulation, normalization of gait pattern)</td>
<td></td>
</tr>
<tr>
<td>Transfers</td>
<td></td>
</tr>
<tr>
<td>Seating and positioning</td>
<td></td>
</tr>
<tr>
<td>Balance</td>
<td></td>
</tr>
<tr>
<td>Wheelchair management and mobility</td>
<td></td>
</tr>
<tr>
<td>Sexuality</td>
<td></td>
</tr>
<tr>
<td>Energy demand reduction</td>
<td></td>
</tr>
</tbody>
</table>

**Increased Ease of Care**

- Dressing
- Feeding
- Hygiene and bathing
- Positioning

**Increased Comfort**

- Pain reduction
- Sleep improvement
- Orthosis fit improvement

**Prevention or Treatment of Musculoskeletal Complications**

- Delay or prevention of contracture
- Increased efficacy of and reduced need for casting
- Prevention of spasm
- Prevention of subluxation
- Pressure sore reduction

**Cosmesis**

- Improved body image
- Increased choice of and tolerance for regular footwear
serve function while promoting other objectives.

3. The clinical team must determine the priority for muscles to be injected, recognizing that in some patients, it is not practical to treat all affected muscles in one session. Staged follow-up injections may be required to treat other muscles, either within the synergy group of the injected muscle, or at sites distant from the original injection. Also, BTX-induced weakness may expose some problematic muscles that were hidden before the original treatment, and these may require attention as well. For instance, injection of wrist flexors may reveal spasticity in the extensors, and change wrist posture from a flexor to an extensor pattern. Treatment of these may be appropriate in some patients, while for others the dominant extensors may provide an acceptable functional posture for the hand.7

4. A range of clinical outcome measures are used to evaluate the patient prior to injection. The choice of measures should be driven by the defined goals and objectives, as discussed by Pierson19 and Albany elsewhere in this syllabus. Videotape documentation before treatment can be a valuable part of the patient’s record.8

Muscle Identification and Localization

A knowledge of the primary clinical patterns of muscle spasticity guides the treating physician,11 though with the understanding that each patient’s treatment must be individualized. The direct neurological examination reveals those muscles which appear to be maximally disabling. It is useful to keep an anatomy textbook and other resources available during the examination and treatment, particularly in view of the variety of clinical patterns of the UMN syndrome. Direct injection via palpation technique may be appropriate for superficial muscles, while guidance by electromyography (EMG) or electrical stimulation (ES) is commonly used to identify deeper muscles, or the specific fascicles within. These injection techniques are discussed by O’Brien elsewhere in this syllabus.11

Dose Determination

Members of the Spasticity Study Group have arrived at a consensus on recommended initial doses and dose ranges, based on our collective clinical experience. Table 3 indicates typical starting doses for an adult of average height and weight. Recommended pediatric doses may be found elsewhere in this syllabus.20 However, additional considerations must be addressed in determining whether to adjust the starting dose within the range given. Dose-modifying conditions are outlined in Table 4. A patient whose clinical profile suggests a lower initial dose may begin with injections at the low end of the range, with the high end appropriate for those patients at the other end of the clinical spectrum. Many clinicians utilize a conservative program early in treatment.

Every patient will develop a portfolio of response to BTX-A therapy. The muscle dose is modified according to the impact of prior treatments and the evolving clinical profile as it changes with therapy. From time to time, a generally effective treatment will prove less so in a particular patient. This should not dissuade one from continuing therapy at regular intervals, if appropriate. If a trend toward decreased response becomes apparent then one needs to reassess muscle selection, dose, site of injection, injection technique, and finally, the potential for antibody-mediated resistance. The potential for immune response is a serious concern, and is the major consideration in limiting the frequency of BTX-A administration and the total dose per session.

KEY POINTS

- The goals of the patient and caregiver ultimately determine the appropriateness of BTX-A therapy
- Although BTX-A is a focal treatment, it may improve function in untreated muscles as well, by breaking up synergy patterns
- In some patients, it may not be practical to treat all affected muscles in one session
- A range of clinical outcome measures are used to evaluate the patient prior to injection
Botulinum toxin A therapy is often the appropriate treatment for the spastic patient with focal, dynamic (as opposed to fixed) contracture, if spasticity is interfering with function. Careful definition of the goals of BTX-A therapy is necessary before treatment proceeds. The clinical team helps patient and caregiver(s) to identify and clarify goals, and evaluates the suitability of BTX-A to meet these goals. Outcome measures, selected for their relevance to the expected benefits of treatment, are applied before the first injection, and then again at an appropriate interval following treatment. An initial dose may be determined from the accompanying dosing chart, though most clinicians will adapt and modify these guidelines based upon the individual patient’s response to therapy. In spasticity treatment, BTX-A injection is almost never used as monotherapy, and adjunctive treatments including physical interventions (such as range of motion exercises, serial casting, or strengthening programs) are instituted or modified following injection.
When the goals of BTX-A treatment have been defined and outcome measures chosen, evaluation of treatment success should be straightforward. When patient or caregiver goals have not been met despite functional improvement, the clinical team works with them to re-evaluate their expectations. When the functional or technical goals of treatment have not been met, some modification of muscle selection, injection technique, or adjunctive therapies may be needed. Continued lack of efficacy even with optimum technique and muscle selection suggests that the patient was poorly selected for BTX-A therapy, the technical goals are inappropriate, or the patient is resistant to BTX-A. Antibody or frontalis testing may be indicated in this situation. Successful treatment does not obviate the need for re-evaluation of goals, treatment program, or dose and injection site. These issues are routinely considered at the follow-up visit, and adjustments made as needed or desired. As always, the patient and caregiver remain at the center of the decision-making process.
## Suggested Adult Botulinum Toxin A Dosing

<table>
<thead>
<tr>
<th>Clinical Pattern</th>
<th>Potential Muscles Involved</th>
<th>Average Starting Dose/Units</th>
<th>BOTOX® Dose Units/Visit</th>
<th>Number of Injection Sites</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Upper Limbs</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Adducted/internally rotated shoulder</td>
<td>pectoralis complex</td>
<td>100</td>
<td>75-150</td>
<td>4</td>
</tr>
<tr>
<td></td>
<td>latissimus dorsi</td>
<td>100</td>
<td>50-150</td>
<td>4</td>
</tr>
<tr>
<td></td>
<td>teres major</td>
<td>50</td>
<td>25-75</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>subscapularis</td>
<td>50</td>
<td>25-75</td>
<td>2</td>
</tr>
<tr>
<td>Flexed elbow</td>
<td>brachioradialis</td>
<td>50</td>
<td>25-75</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>biceps</td>
<td>100</td>
<td>50-200</td>
<td>4</td>
</tr>
<tr>
<td></td>
<td>brachialis</td>
<td>50</td>
<td>25-75</td>
<td>2</td>
</tr>
<tr>
<td>Pronated forearm</td>
<td>pronator quadratus</td>
<td>25</td>
<td>10-50</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>pronator teres</td>
<td>40</td>
<td>25-75</td>
<td>1</td>
</tr>
<tr>
<td>Flexed wrist</td>
<td>flexor carpi radialis</td>
<td>50</td>
<td>25-100</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>flexor carpi ulnaris</td>
<td>40</td>
<td>10-50</td>
<td>2</td>
</tr>
<tr>
<td>Thumb-in-palm</td>
<td>flexor pollicis longus</td>
<td>15</td>
<td>5-25</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>adductor pollicis</td>
<td>10</td>
<td>5-25</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>opponens</td>
<td>10</td>
<td>5-25</td>
<td>1</td>
</tr>
<tr>
<td>Clenched fist</td>
<td>flexor digitorum superficialis</td>
<td>50</td>
<td>25-75</td>
<td>4</td>
</tr>
<tr>
<td></td>
<td>flexor digitorum profundus</td>
<td>15</td>
<td>25-100</td>
<td>2</td>
</tr>
<tr>
<td>Intrinsic plus hand</td>
<td>lumbricales intersossei</td>
<td>15</td>
<td>10-50/hand</td>
<td>3</td>
</tr>
<tr>
<td><strong>Lower Limbs</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Flexed hip</td>
<td>iliacus</td>
<td>100</td>
<td>50-150</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>psoas</td>
<td>100</td>
<td>50-200</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>rectus femoris</td>
<td>100</td>
<td>75-200</td>
<td>3</td>
</tr>
<tr>
<td>Flexed knee</td>
<td>medial hamstrings</td>
<td>100</td>
<td>50-150</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>gastrocnemius (as knee flexor)</td>
<td>150</td>
<td>50-150</td>
<td>4</td>
</tr>
<tr>
<td></td>
<td>lateral hamstrings</td>
<td>100</td>
<td>100-200</td>
<td>3</td>
</tr>
<tr>
<td>Adducted thighs</td>
<td>adductor brevis/longus/magnus</td>
<td>200/leg</td>
<td>75-300</td>
<td>6/leg</td>
</tr>
<tr>
<td>Stiff (extended) knee</td>
<td>quadriceps mechanism</td>
<td>100</td>
<td>50-200</td>
<td>4</td>
</tr>
<tr>
<td>Equinovarus foot</td>
<td>gastrocnemius medial/lateral</td>
<td>100</td>
<td>50-200</td>
<td>4</td>
</tr>
<tr>
<td></td>
<td>soleus</td>
<td>75</td>
<td>50-100</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>tibialis posterior</td>
<td>50</td>
<td>50-200</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>tibialis anterior</td>
<td>75</td>
<td>50-150</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>flexor digitorum longus/brevis</td>
<td>75</td>
<td>50-100</td>
<td>4</td>
</tr>
<tr>
<td></td>
<td>flexor hallucis longus</td>
<td>50</td>
<td>25-75</td>
<td>3</td>
</tr>
<tr>
<td>Striatal toe</td>
<td>extensor hallucis longus</td>
<td>50</td>
<td>20-100</td>
<td>2</td>
</tr>
<tr>
<td><strong>Neck</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>sternocleidomastoid (SCM)†</td>
<td>40</td>
<td>15-75</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>scalenus complex</td>
<td>30</td>
<td>15-50</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>splenius capitis</td>
<td>60</td>
<td>50-150</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>semispinalis capitis</td>
<td>60</td>
<td>50-150</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>longissimus capitis</td>
<td>60</td>
<td>50-150</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>trapezius</td>
<td>60</td>
<td>50-150</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>levator scapulae</td>
<td>80</td>
<td>25-100</td>
<td>3</td>
<td></td>
</tr>
</tbody>
</table>

†The dose should be reduced by 50% if both SCM muscles are injected.

### Dosing Guidelines:
- Total maximum dose per visit = 400 Units
- Maximum dose per injection site = 50 Units
- Maximum volume per site = 0.5mL, except in select situations
- Reinjection >3 month
Although not all variables necessary to provoke an immune response are known, it appears prudent to avoid injections more often than every 3 months, and to avoid doses higher than 300 to 400 U per session. Further discussion of resistance is found elsewhere in this syllabus.4 Certain conditions may contraindicate BTX-A use or require caution and close observation during treatment, including pregnancy, lactation, and neuromuscular disease. A fuller discussion appears elsewhere in this syllabus.4 We also recommend caution for patients taking aminoglycoside antibiotics concurrently, as these may potentiate BTX action.

The lethal parenteral dose of BTX-A in humans is unknown, but is estimated at approximately 3000 U,4 making accidental intramuscular injection of the lethal dose highly unlikely. An antitoxin is available from the Centers for Disease Control. Because it contains equine immunoglobulins, it has been reported to provoke hypersensitivity reaction in up to 9% of those receiving it.23 In children, dosing is further limited by body weight and a slightly higher concern for systemic toxicity. Most clinicians recommend restricting the total BTX-A injected at each session to the lesser of 12 U/kg or 400 U. Further guidelines are found in Russman et al.20

Dilution and Handling

BTX-A is available worldwide under the trade name BOTOX® (Allergan) and in Europe as Dysport® (Speywood). BOTOX® is supplied in 100 U vials and can be diluted to a variety of concentrations. Determination of the appropriate dilution requires consideration of the size of the target muscle, the concern for diffusion, and the desired level of effect. For most muscles of average size, a concentration of 5 to 10 U/0.1 mL is appropriate, with a volume of up to 0.5 mL per site. Injection of larger volumes should be avoided, both to prevent diffusion beyond the target area, and in principle to reduce exposure of the toxin to the immune system.

<table>
<thead>
<tr>
<th>Clinical situation</th>
<th>Dose per muscle</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>A decrease in dose may be indicated if:</td>
</tr>
<tr>
<td>Patient weight</td>
<td>Low</td>
</tr>
<tr>
<td>Likely duration of therapy</td>
<td>Chronic</td>
</tr>
<tr>
<td>Muscle bulk</td>
<td>Very small</td>
</tr>
<tr>
<td>Number of muscles being injected simultaneously</td>
<td>Many</td>
</tr>
<tr>
<td>Ashworth score</td>
<td>Low</td>
</tr>
<tr>
<td>Concern that treatment may result in excess weakness</td>
<td>High</td>
</tr>
<tr>
<td>Results of previous therapy</td>
<td>Too much weakness</td>
</tr>
</tbody>
</table>

**KEY POINTS**

- Injection of larger volumes should be avoided, both to prevent diffusion beyond the target area, and in principle to reduce exposure of the toxin to the immune system
the immune system. In very tiny muscles, such as those that subserve the fingers, a smaller volume with higher concentration may be desirable; a standard concentration range is 10 to 20 U/0.1 mL with an injected volume of perhaps 0.1-0.2 mL per site.

BTX-A is reconstituted in the vial with normal saline without preservative. The vial is gently swirled, but not shaken or agitated. After treatment, any remaining toxin is disposed of according to local guidelines. In most treatment centers, the toxin is discarded in a sealed disposable biohazard container. The United States Food and Drug Administration labeling recommends that clinicians inject or dispose of reconstituted toxin within 4 hours of reconstitution. In some practices, injection appointments are clustered to reduce wasting of partially used vials. A recent report, however, suggests that BOTOX® may retain its potency for at least 2 weeks after reconstitution when refrigerated or frozen. Nonetheless, we recommend not reusing frozen reconstituted toxin, because the freeze-thaw cycle may alter protein structure and could theoretically increase antigenicity.

**Number of Injection Sites**

The appropriate number of injection sites is a function of the size of the muscle. The recommendations of the Spasticity Study Group for adults are summarized in Table 3. Pediatric recommendations are discussed by Russman et al. elsewhere in this syllabus. It is probably preferable to inject more sites with smaller volumes, rather than one site with one large volume. The increased number of sites provides a more even distribution throughout the muscle, with a potentially greater likelihood of reaching the most nerve terminals. However, this approach must be balanced against the undesirability of injection where no nerve terminals are present, such as at the musculotendinous junction. In pediatric patients, one may choose to decrease the number of injection sites to minimize the discomfort associated with injection.

**Clinical Procedure**

A sample patient encounter form is included at the end of this syllabus.

Prior to injection, informed consent is obtained and patients are familiarized with the procedure and the necessary equipment (including EMG or ES if needed) by the medical staff. To reduce bleeding at the injection site, patients with a history of clotting disorder may be advised to avoid anticoagulant drugs, unless medically necessary, for up to 2 weeks before injection, particularly for deep muscles such as the psoas. Modification of an anticoagulant program is made with the advice of the patient's internist. Pre-injection outcome assessments are often re-examined on the day of injection. The patient's current neurological and rehabilitation status is charted. In pediatric patients, a sedative or topical anesthetic may be administered. However, in most adults, no anesthetic is used. Physical discomfort is limited to the injection; electrical stimulation, if used, is usually well-tolerated. The use of EMG and electrical stimulation is detailed by O'Brien elsewhere in this syllabus.

Adverse effects are relatively uncommon. There may be some local discomfort or pain at the injection site, and in rare situations, a rash. Rarely, we have seen a vasovagal reaction associated with injection, but have not deemed it a direct effect of the toxin, as its frequency is similar to that seen after a diagnostic electromyogram. In almost all cases, therefore, the patient may resume routine daily activities following injection.

**Onset and Duration of Therapeutic Effects**

Most patients begin to feel a therapeutic effect within 24 to 72 hours after injection, with the peak effect occurring at approximately 2 weeks. This peak effect may be enhanced by reinstituting physical therapy a
week after treatment, as discussed by 
Albany. Reassessment of the patient is usu-
ally performed by the physical therapist 1-2 
weeks after the initial injection, and by the 
treating physician at 3-6 weeks, though 
these intervals may vary with the needs of 
the patient or caregiver. The impact of ther-
apy and preliminary decisions regarding 
future therapeutic strategy are noted in the 
patient's record.

Clinical benefit usually lasts for approxi-
mately 12 weeks, though in some patients 
the duration of effect may be longer. In our 
experience, functional activity and adjunc-
tive therapies can prolong the duration of 
beneficial effects.

Re-treatment

While BTX-A treatment can provide impor-
tant clinical improvement in many patients, 
it is not a panacea for every patient with 
spasticity. The treating physician must 
decide with the clinical team, the patient, 
and the caregiver whether re-treatment is 
appropriate, based on the response seen 
with each injection. The same questions 
regarding re-treatment should be asked at 
each follow-up visit, and neither the patient 
nor the physician should regard the decision 
to re-treat as a foregone conclusion.
Assessment of the patient's clinical and func-
tional status is a critical aspect of each fol-
low-up appointment, and the contribution 
of BTX-A therapy to reaching the goals of 
the patient and caregiver must be evaluated. 
Other therapeutic options should be consid-
ered where appropriate, and the treatment 
plan revised when necessary.

Each follow-up visit is a good time to deter-
mine the appropriateness of the toxin dose, 
considering both the effectiveness of the 
spasticity reduction and any excess weak-
ness or other side effects (see Table 4). 
Other dose modifying factors are reconsid-
ered as well, including any changes in med-
ications for other conditions which may 
have occurred between visits.

Case History

A 47-year-old man was referred by his 
physiatrist for possible BTX injections. 
The patient had a spinal cord injury nearly 
20 years ago, causing an incomplete 
mid-thoracic spastic paraparesis. 
Hypertonicity of the thigh adductors led 
to profound scissoring. His sensation was 
intact, and he had developed compensato-
ry strategies with forearm crutches. The 
patient obtained only minimal benefit 
from oral baclofen and was not interested 
in other oral medications or intrathecal 
baclofen.

On examination, the patient had no weak-
ness but displayed extremely powerful 
thigh adductors. He had a "crouch" gait 
with marked scissoring and was unable to 
lift his feet over low objects encountered 
while walking with his crutches.

Initial treatment was attempted with 
EMG-guided injections into the adductor 
muscles (longus, brevis, and magnus) of 
200 U BOTOX® on each side. The patient 
tolerated the procedure well, but showed 
no clinical benefit. The postinjection 
assessment at 3 weeks revealed a slight 
reduction of adductor power, but no 
change in gait. Bilateral phenol neurolysis 
of the obturators was then performed as 
an alternative. Ashworth scores dropped 
from 3.5 to 1.0, and the patient's gait 
 improved significantly. Subsequent treat-
ment included repeat phenol obturator 
blocks and BTX-A injection for medial 
hamstrings (which were also contributing 
to the adductor tone) and toe flexors.

This case illustrates some of the limita-
tions of BTX-A treatment. The power and 
bulk of the adductors exceeded the weak-
ening ability of 400 U of BOTOX®. As 
long-term treatment was likely to be need-
ed, and since 400 U is the usual maxi-
mum dose per treatment session, higher 
doses of BTX-A were not recommended. 
The larger, proximal muscles, supplied by 
a pure motor nerve, carried a relatively 
low risk for complications from phenol 
block. BTX-A was used for the smaller 
medial hamstrings and toe flexors, where 
phenol blockade would carry a greater 
risk. The outcome of this combined 
approach was excellent.
Office Procedure

The patient's chart includes the concentration, dose per injection, number of injection sites, and total dose administered. While each vial of BOTOX® contains 100 U, not all of the toxin may be extracted from each vial. Therefore, it is good practice to chart the actual number of units given, in addition to how many vials were used. The chart should also reflect the evaluation of clinical status and the re-treatment decision-making process that occurs during follow-up visits. Diagnosis (ICD-9) and billing (CPT) codes used in the United States related to BTX-A therapy are shown in Table 5.

Diagnosis (ICD-9) and billing (CPT) codes related to BTX-A therapy are shown in Table 5.

CPT Billing Codes and ICD-9 Codes for Treatment of Spasticity with Botulinum Toxin Type A

<table>
<thead>
<tr>
<th>CPT Billing Codes*</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>64640</td>
<td>Destruction by neurolytic agent; other peripheral nerve or branch</td>
</tr>
<tr>
<td>90782</td>
<td>Therapeutic or diagnostic injection (specify material injected); subcutaneous or intramuscular</td>
</tr>
<tr>
<td>90799</td>
<td>Unlisted procedure</td>
</tr>
<tr>
<td>J0585</td>
<td>BOTOX (Medicare code)</td>
</tr>
<tr>
<td>95869</td>
<td>EMG</td>
</tr>
<tr>
<td>95860</td>
<td>EMG</td>
</tr>
<tr>
<td>99070</td>
<td>Ancillary materials and supplies (these are not reimbursable by Medicare)</td>
</tr>
</tbody>
</table>

* 64640 is the accepted CPT code for spasticity injections in most states, although several Medicare carriers currently list either 90799 or 90782 as the code of choice. 90799 is a code for an unlisted procedure; the injector negotiates the fee with the local carrier. 90782 is a code for a very low reimbursement, which is not deemed to represent the degree of technical difficulty and necessary expertise that characterize spasticity injections.

ICD 9 Codes

<table>
<thead>
<tr>
<th>Code</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>334.1</td>
<td>Hereditary spastic paraplegia</td>
</tr>
<tr>
<td>340</td>
<td>Multiple sclerosis</td>
</tr>
<tr>
<td>341.0-9</td>
<td>Other demyelinating disease</td>
</tr>
<tr>
<td>342.1-2</td>
<td>Spastic hemiplegia</td>
</tr>
<tr>
<td>343.0-9</td>
<td>Intamile cerebral palsy</td>
</tr>
<tr>
<td>728.85</td>
<td>Spasm of muscle</td>
</tr>
<tr>
<td>729.89</td>
<td>Other musculoskeletal symptoms referable to limbs</td>
</tr>
<tr>
<td>729.82</td>
<td>Other musculoskeletal symptoms referable to limbs, cramps</td>
</tr>
<tr>
<td>907.0</td>
<td>Late effect of intracranial injury without mention of spinal cord injury</td>
</tr>
<tr>
<td>907.20</td>
<td>Spasticity due to late effect of spinal cord injury</td>
</tr>
</tbody>
</table>

†Codes used in the United States.

Conclusion

Botulinum toxin is an effective long-term or acute treatment intervention for many patients with spasticity. Functional objectives should be clearly outlined before treatment, and these must be consistent with the goals of the patient and caregiver. Adjunctive therapies and follow-up evaluation are critical parts of the treatment program. BTX-A therapy cannot substitute for the physical and occupational therapy that form the foundation of any treatment program. BTX-A has become an integral part of a comprehensive treatment plan for many patients.

KEY POINTS

- Clinical benefit usually lasts for approximately 12 weeks
Bibliography


