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Botulinum toxin application in hemiplegic patients: a narrative review of indications, techniques, functional benefits, and clinical limitations.

Botulinum toxin application in hemiplegic patients: narrative review on indications, techniques, functional benefits, and clinical limitations

Application of botulinum toxin in hemiplegic patients: narrative review on indications, techniques, functional benefits and clinical limitations

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Summary

Hemiplegia is a neurological condition frequently associated with stroke, traumatic brain injury, cerebral palsy, and other central nervous system lesions, resulting in significant motor impairments, especially focal and global spasticity. Botulinum toxin has been widely used as a therapeutic resource in the management of spasticity in hemiplegic patients, contributing to the reduction of muscle tone, improvement in range of motion, pain relief, facilitation of daily care, and the potential for functional enhancement when associated with rehabilitation. This article aims to discuss, in a narrative format, the main aspects of botulinum toxin application in hemiplegic patients, including mechanisms of action, indication criteria, commonly treated muscles, application techniques, clinical benefits, limitations, and future perspectives. It is observed that botulinum toxin represents a safe and effective intervention for the treatment of focal spasticity, provided it is employed in a multidisciplinary context, with a clear definition of therapeutic goals and adequate functional follow-up. Despite the widely documented benefits, the clinical response depends on the correct patient selection, the time elapsed since the neurological injury, the spastic pattern presented, and the combination with physiotherapy, occupational therapy, and complementary rehabilitation strategies.

Keywords: botulinum toxin; hemiplegia; spasticity; neurological rehabilitation; stroke.

Abstract

Hemiplegia is a neurological condition commonly associated with stroke, traumatic brain injury, cerebral palsy, and other central nervous system disorders, often resulting in significant motor impairment, especially focal or generalized spasticity. Botulinum toxin has been widely used as a therapeutic agent to manage spasticity in hemiplegic patients, contributing to reduced muscle tone, improved range of motion, pain relief, facilitation of daily care, and potential functional gains when associated with rehabilitation. This article aims to discuss, in a narrative manner, the main aspects of botulinum toxin application in hemiplegic patients, including mechanisms of action, indication criteria, commonly treated muscles, injection techniques, clinical benefits, limitations, and future perspectives. Botulinum toxin appears to be a safe and effective intervention for the treatment of focal spasticity, provided it is used within a multidisciplinary framework, with clearly defined therapeutic goals and appropriate functional follow-up. Despite its well-documented benefits, clinical response depends on proper patient selection, time since neurological injury, spastic pattern, and association with physiotherapy, occupational therapy, and complementary rehabilitation strategies.

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1. Introduction

Hemiplegia is characterized by the loss or severe reduction of motor function in one side.
half of the body and, in most cases, results from unilateral brain lesions (Sommerfeld et al.,
2004; Lance, 1980). Among the main etiologies, stroke stands out,
traumatic brain injury, tumors, central nervous system infections and certain
Encephalopathies. Furthermore, this condition commonly progresses to spasticity, defined as...
a motor disorder characterized by a velocity-dependent increase in the tonic reflex of
Stretching, associated with upper motor neuron syndrome.

In this scenario, spasticity in hemiplegic patients can lead to a series of...
Relevant clinical complications, such as pain, deformities, joint limitations, and impaired function.
gait, difficulty performing hygiene, impaired body positioning, and
Consequently, a reduction in functional independence (Pandyan et al., 2005). Given these
Despite the repercussions, botulinum toxin has become established as one of the main approaches.
Therapeutic for focal spasticity, as it promotes reversible blockade of the junction.
neuromuscular, resulting in the selective reduction of muscle hyperactivity.

Furthermore, it is observed that the therapeutic use of botulinum toxin in the areas of neurology and
The field of physical medicine has expanded progressively over the last few decades, being applied
in different muscle groups and often associated with structured programs of
rehabilitation. Therefore, in hemiplegic patients, its use should be carefully considered.
Individualized, guided by specific therapeutic goals and integrated into a functional approach.
broad, aiming to maximize clinical and functional gains.

Thus, given the clinical relevance of spasticity and its impacts on functionality and
In terms of the quality of life of hemiplegic patients, it becomes essential to understand, in a comprehensive way...
In depth, the role of botulinum toxin as a therapeutic strategy, as well as its indications,
Benefits and limitations in the context of neurological rehabilitation.

2. Objective

This study aims to analyze the application of botulinum toxin in patients.
hemiplegic patients, considering, in an integrated way, their physiological foundations, the main
Clinical indications and administration techniques employed. Furthermore, it seeks to address the...

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main target muscles involved in the treatment, as well as the therapeutic benefits.
The observations and potential limitations of this intervention were considered. Finally, the aim is to highlight the relevance...
of the multidisciplinary approach in the rehabilitation process, emphasizing its contribution to the
Optimization of functional results.

3. Methodology

This is a narrative review, descriptive and analytical in nature, developed based on...
in consolidated knowledge about the use of botulinum toxin in the management of spasticity in
Hemiplegic patients. Scientific articles were used in the construction of this study.
indexed in recognized databases, such as PubMed and Scopus, employing strategies of
Structured searches using Boolean operators AND, OR, and NOT, in order to optimize selection and...
combination of descriptors.

The text was structured for academic and scientific purposes, prioritizing integration between
aspects of pathophysiology, clinical practice, and functional rehabilitation. Furthermore, for the purposes of
When submitting to an international journal, supplementary review is recommended.
A systematic review of the literature in indexed databases, as well as compliance with the journal's standards,
target and the incorporation of updated references.

4. Development

4.1 Hemiplegia and spasticity

Following injury to the corticospinal tract and descending modulatory pathways, a
An imbalance between the excitatory and inhibitory mechanisms responsible for motor control. How
As a result, this process promotes reflex hyperexcitability, increased muscle tone, and...
the emergence of abnormal synergistic patterns. In this context, in hemiplegic patients, the
Spasticity tends to affect the upper limb more frequently in a flexor pattern.
while the lower limb is predominantly affected in an extensor pattern.

With regard to the upper limb, changes such as the following are frequently observed.
Shoulder adduction, elbow flexion, and forearm pronation, in addition to wrist and finger flexion.
frequently associated with thumb adduction. In turn, in the lower limb, the following stand out:
Knee extension, plantar flexion, and foot inversion are conditions that can compromise
significantly affects balance, plantar support, and gait pattern. Therefore, such changes...

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They directly interfere with the patient's functionality and quality of life.

4.2 Mechanism of action of botulinum toxin

Botulinum toxin is a neurotoxin produced by the bacterium Clostridium *botulinum.*
The mechanism of action is based on the inhibition of acetylcholine release at the presynaptic terminal.
from the neuromuscular junction, resulting in temporary and reversible muscle weakness.
(Dressler & Saberi, 2005; Rossetto et al., 2014). In this context, among the different serotypes
Of the existing types, type A stands out as the most widely used in clinical practice, mainly
due to its high efficacy and longer duration of therapeutic effect.

Furthermore, the clinical effects of the application tend to manifest a few days after the
The procedure reaches its peak between two and six weeks. Subsequently, a
The average duration of action is approximately three to four months. However, it is important to emphasize
that this response may vary depending on factors such as the dose administered, the technique used, the
The selected target muscle and the individual characteristics of each patient.

4.3 Indications in hemiplegic patients

The primary indication for botulinum toxin in hemiplegic patients is the treatment of
Focal or multifocal spasticity that impairs function, causes pain, and hinders hygiene,
It promotes the development of deformities or limits the use of orthotics and the performance of activities.
of daily living (Simpson et al., 2016).

In this context, therapeutic goals should be carefully individualized, and may
include reducing muscle tone, improving limb positioning, and facilitating
Palmar, axillary, or perineal hygiene, pain relief, prevention of contractures, gait improvement,
Assistance in the use of orthotics, in addition to functional gain, whether passive or active. Furthermore, the
Intervention can make care provided by family members and caregivers easier.

Finally, it should be noted that the most appropriate indication occurs when spasticity is
Clearly identifiable in a focal manner, there is still no established severe fixed contracture, and the patient
It is part of a consistent rehabilitation program, which enhances the results.
therapeutic.

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4.4 Main Target Muscles

The choice of muscles to be infiltrated depends fundamentally on an assessment. Detailed clinical analysis of the patient's motor pattern, as well as previously defined functional goals. established. Therefore, the proper selection of target muscles is an essential step in therapeutic planning.

In hemiplegic upper limbs, muscles such as the biceps are frequently addressed. brachialis, the brachialis, the brachioradialis, the pronator teres, the flexor carpi radialis, the flexor carpi ulnaris of the carpus, the superficial flexor of the fingers, the deep flexor of the fingers, the adductor pollicis, the flexor long thumb, in addition to the pectoralis major and, in selected cases, the subscapularis.

In turn, in the lower limb, the most commonly treated muscles include the gastrocnemius, soleus, tibialis posterior, flexor digitorum longus, hamstrings, rectus abdominis femoral and hip adductor muscles.

Therefore, the accurate identification of hyperactive muscles proves fundamental for to maximize the therapeutic effect of the intervention, while also contributing to the Minimizing inappropriate motor compensations.

4.5 Application techniques

The application of botulinum toxin can be performed based on anatomical landmarks. as well as with the aid of resources such as electrostimulation, electromyography or ultrasound (Picelli et al., 2012). In this context, image-guided or image-guided methods Specific instruments tend to significantly increase the accuracy of infiltration, especially in deeper or smaller muscles, where isolated clinical identification may to be more challenging.

Furthermore, determining the dose should consider several factors, including the formulation. used, the size of the muscle, the intensity of spasticity, the clinical pattern presented, the The interval since previous applications and the risk of excessive muscle weakness. Furthermore, it is It is important to highlight that different trademarks do not have direct unit equivalences. which requires specific knowledge of the product used to ensure its safety and effectiveness. treatment.

Finally, the application technique must strictly follow the principles of asepsis and This involves individualized muscle planning. Documentation is also essential. carefully assess the infiltrated areas, the dose administered per point, and the subsequent clinical response.

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which allows for proper monitoring and future therapeutic adjustments.

4.6 Clinical and functional benefits

The benefits of botulinum toxin in hemiplegic patients go beyond simply reducing swelling.
of muscle tone. In many cases, an improvement in segmental alignment is observed, along with greater ease of movement.
passive mobilization, less pain associated with spasm, improved postural pattern and increased
effectiveness of combined therapies.

In patients with residual motor potential, reducing muscle hyperactivity
Spastic conditions can favor more efficient recruitment of antagonistic groups and improve performance.
in specific tasks (Gracies et al., 2015). Even when there is no active motor recovery.
Expressive intervention can bring important benefits by facilitating hygiene, dressing, and...
Positioning in bed, wheelchair adaptation, and prevention of complications.
osteomyoarticular.

In the lower limb, gait pattern improvement can occur through better support.
Plantar flexion, reduction of dynamic equinovarus, and increased safety during transfers. No
upper limb, palmar opening and reduced flexion can facilitate care and alleviate the
discomfort.

4.7 Limitations and adverse effects

Although considered a safe procedure, botulinum toxin has limitations.
Its effect is temporary and requires periodic reapplication. Furthermore, it does not replace treatment.
comprehensive rehabilitation, being most effective when integrated with physiotherapy, occupational therapy, and other therapies.
stretching, selective strengthening, functional training, and the use of orthotics.

Among the most commonly described adverse effects are local pain, excessive muscle weakness, and edema.
Bruising and, rarely, unwanted systemic effects. In some cases, contractures may be present.
Fixed or structural deformities significantly reduce the clinical benefit of the application. Another
An important point is the possibility of a suboptimal response due to inadequate muscle selection.
poorly defined therapeutic targets or goals.

4.8 Importance of a multidisciplinary approach

The best response to botulinum toxin treatment occurs when the injection is inserted.
in a multidisciplinary therapeutic plan. The integrated action between physiotherapist, physiatrist

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or neurologist, occupational therapist, nursing staff, speech therapist and caregivers allow
Set realistic goals and track relevant outcomes.

After application, the period of greatest pharmacological effect should be used to take advantage of it. Intensive stretching strategies, motor training, functional rehabilitation, serial orthotics, when indicated, and stimuli directed towards activity and participation. In this way, the toxin ceases to be It is not just a muscle relaxation tool, but it also acts as a facilitator of therapeutic gains. wider.

5. Discussion

The use of botulinum toxin in hemiplegic patients has transformed the management of spasticity. It focuses on allowing for selective, reversible, and relatively safe intervention. Its effectiveness is more This is evident when treatment is guided by concrete goals, such as improving gait and hygiene. Palmar, shoulder positioning, or adaptation to the use of orthoses.

Clinical literature generally supports consistent benefits in reducing muscle tone and in... Relief of problems associated with spasticity. However, the gains are strictly functional. There are differences between studies, possibly due to the heterogeneity of patients and instruments. assessment methods used and the variability in the intensity of associated therapies. Thus, the simple A decrease in spasticity does not always automatically translate into functional independence. especially in patients with severe motor deficits, significant sensory impairments, or with long time for the lesion to develop. (Baker & Pereira, 2013).

Another relevant aspect concerns the need for a biomechanical and neurological assessment. detailed. Not every increase in muscle tone represents an ideal target for the toxin, and not every limitation Functional impairment stems primarily from spasticity. Weakness, loss of selective control, co-Contraction, contracture, and alterations in body schema can coexist and influence the outcome. end.

In this scenario, botulinum toxin should be understood as part of a strategy.
A broader therapeutic approach, not a solution in isolation. Its real contribution occurs when combined with other treatments. rehabilitation is guided by measurable functional goals and periodic reassessments.

Conclusion

The application of botulinum toxin in hemiplegic patients constitutes an important A therapeutic tool in the management of focal spasticity, with a positive impact on pain, the

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positioning, range of motion, ease of care and, in many cases, the
Functional performance. Its use should be individualized, based on clinical evaluation.
meticulous, in the appropriate selection of target muscles and in the prior definition of therapeutic objectives.

The best results are seen when the intervention is integrated into a program.
multidisciplinary rehabilitation, with continuous functional monitoring. Despite their
Despite limitations and the need for periodic reapplication, botulinum toxin continues to play a role.
relevant in contemporary clinical practice, contributing to a better quality of life and to
a greater potential for rehabilitation in hemiplegic patients.

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