Ultrasound Guided LANTOX Injection Technique-A New Method in Treating Extremities Spasticity Following Stroke

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Abstract

Objective: To evaluate the feasibility and its value of ultrasound guided LANTOX injection technique in treating extremities spasticity following stroke.

Methods: 5 patients with extremity spasticity following stroke were recruited in this clinical study. Under guideline of upper and lower limb muscle color atlas, combined with color ultrasound examination. The botulinum toxin type A was injected into muscles as follow, flexor carpi radialis, flexor carpi ulnaris, superficial/ deep flexor muscle of fingers, flexor hallucis longus, long palmar muscle, soleus, gastrocnemius, tibialis posterior, flexor digitorum longus etc. The outcome after LANTOX injection was assessed by modified Ashworth Scale (MAS), Fugl-Meyer Assessment-upper limb (FMA-upper limb), Motor-Functional Independence Measure-upper limb (mot-FIM-upper limb), step length and velocity, at the baseline, 2-week and 4-week after treatment respectively.

Results: Compared the sores of MAS, FMA-upper limb, FIM-upper limb, step length and velocity after 2 and 4 weeks after treatment, there is significant difference statistically ($p<0.05$).

Conclusion: Under localized atlas, ultrasound guided LANTOX injection technique is an accurate positioning method in using LANTOX to treat extremities muscle spasticity. Compared with other muscle injection localization, ultrasound guided method possesses higher practice value.

Key words: Muscle color localized atlas, Ultrasound guided injection, LANTOX

LANTOX injection is now widely applied in the treatment of myospasm. A new ultrasound guided LANTOX injection technique has been paid attention recently. Under the guidance of ultrasound, the injection is effective in taking action on salivary gland and preventing salivation caused by cerebral palsy and Parkinson's disease. In this study, ultrasound guided LANTOX injection technique was used to treat extremities spasticity following stroke. The results were shown as follows.

1) Clinical Information

1.1 Patients

Among the patients with cerebral apoplexy in the hospital, 5 of them received ultrasound guided LANTOX injection technique from January to June, 2007. 3 patients

had talipes equinovalgus and 2 had disease of pinch-grip. Patients' information was shown in Table 1.

1.1.1 Requirement of Intake

1) Diagnosis met the standard of cerebral infarction and cerebral hemorrhage in China's Cerebrovascular Disease Prevention Guidelines approved by Chinese Medical Association Neuropathy Credits in 2004.
2) Proof from CT or MRI scan.
3) Initial incidence of diseases.
4) Age range from 45 to 70.
5) Hemiplegia
6) When passive wrist joint or finger joint extended, modified Ashworth Scale (MAS) was higher than level 2.
7) When passive ankle joint stretched, MAS was higher than level 2.
8) Capability of walking independently with at least a distance of 10m.

1.1.2 Requirement of Elimination

1) History of cerebral apoplexy for more than 1 year.
2) Fixed contracture of elbow, wrist and finger joints.
3) Infection at the site of injection.
4) Intake of medicine which blocks blocking neuromuscular junction transmission such as aminoglycoside antibiotic within 1 week.
5) Pregnancy, breast-feeding or history of LANTOX treatment.

Table 1. General information of patients

Frequency	Age (Year)	Period (Days)	Number of ankle planter flexors	Number of carpophalangeal flexors	Sex		Diagnosis	
					Male	Female	Hemorrhage	Infarction
5	58.88±7.94	62.50±9.10	3	2	3	2	3	2

1.2 Rehabilitation Assessment

Assessment was taken before injection, at 2 and 4 weeks after injection. Assessment was undergone by another physician. This physician was not involved in the injection process and rehabilitation training. The following information was included in the assessment.

1.2.1 Muscle Tension Modified Ashworth scale (MAS)

1.2.2 Gait Analysis Walking distance was measured by foot-printing. Patients were

required to walk for 10m. Mean value of 3 step lengths was taken 6m at the middle. Walking time was required so that the velocity was known.

1.2.3 Motor Function Fugl-Meyer Assessment-upper limb (FMA-upper limb)

1.2.4 Activities of Daily Life (ADL) Motor-Functional Independence Measure-upper limb (mot-FIM-upper limb), including eating, dressing, bathing and going to toilet.

1.3 Method

1.3.1 Ultrasound guided injection of LANTOX

5 patients had LANTOX injection under the guidance of ultrasound. LANTOX is the crystallized toxin manufactured by Lanzhou Institute of Biological Products. The treatment took place in Ultrasound Room B with the apparatus of colour Doppler's ultrasonic diagnosis apparatus from GE Company Ltd, US and detector model M12L.

Steps of operation were as follows.

1) For upper limb injection, patients were in a state of supination. For lower limb injection, patients were in a state of pronation instead.

2) The site of injection was sterilized by iodine. Coupling agent was applied at the ultrasound detector. The detector was covered by a sterilized plastic bag (condom for men use). The plastic bag was then sterilized by iodine.

3) Normal saline water was extracted using 50ml syringe. When detector moved on the skin surface, the syringe injected saline water between the detector and the skin. Saline water was used to replace ultrasound coupling agent.

4) With the guidance of localized atlas, the detector localized target muscle and cross-sectional area. The length and the volume of the muscle were estimated to confirm the number of injection sites and dosage.

5) After confirming the location of target muscle, the syringe was inserted into skin with tilt. With the guidance of ultrasound, LANTOX was injected into the following muscles, including flexor carpi radialis, flexor carpi ulnaris, superficial/ deep flexor muscle of fingers, flexor hallucis longus, long palmar muscle, soleus, gastrocnemius, tibialis posterior, and flexor digitorum longus.

6) 2.5-5u was injected at each site. The dosage and overall amount of dosage were determined by the size of the muscle and the spasticity.

1.3.2 Use of Orthotics and Rehabilitation Training

Patients wore ankle orthotics or anti-spasticity splint 2 days after injection. They received regular rehabilitation trainings such as passive joint movement and flexion technique and therapeutic movement training such as ADL, electrical stimuli, Chinese medicine fumigating, massage, acupuncture etc.

1.3.3 Statistics Analysis

All information was expressed in terms of x±s. The data was analyzed by software SPSS 12.0. The t test was used for quantitative data and the chi-square test was used for ranked data.

2) Results

Table 2 showed the assessment in MAS, FMA-upper limb, mot-FIM-upper limb, step length and velocity before and after injection. Different localized techniques such as touching, multi-channeled myography, ultrasound, CT scan, gait analysis etc. Their pros and cons are shown in Table 2.

Table 2 Variation in assessments before and after LANTOX injection

Evaluation	Before injection	2 weeks after injection	4 weeks after injection
MAS (marks)	3.38±0.59	1.58±0.57	2.2±0.57
FMA-upper limb (marks)	11.3±2.31	13.9±2.74	19.3±2.3
Mot-FIM-upper limb (marks)	16.35±2.17	20.45±2.18	23.4±2.29
Velocity (m/s)	0.24±0.08	0.27±0.07	0.32±0.09
Step length (m)	0.38±0.06	0.44±0.06	0.54±0.05

Note: Comparison between pre-injection and post-injection: Comparison between 2 and 4 weeks after injection and pre-injection $P<0.05$

3) Discussion

3.1 LANTOX injection is now commonly used in treatment of muscle spasticity caused by upper motoneuron injury. The key to precise result is to localize the muscle correctly.

Table 3 Comparison of different localized techniques

Technique	Pros	Cons	Suitable for
Electric Stimuli	Precise localization. Injection close to neuromuscular junctions	Time consuming. Response depends on individuals and strength of stimuli	Patients with low voluntary movements and severe spasm. Isolated muscle groups, e.g. hands, upper arm muscles.
Myography	Paroxysmal myoelectricity(motor unit potential) is	Time consuming, invasive. For special group	Deep and small muscle, e.g. cervical dystonia,

	measured during muscle relaxation so that degree of spasticity, and muscle and area involved are determined. Location of neuromuscular junction can be found.	(children), there is difference between muscle localization and injection site due to poor coordination. Require professional operation technique.	facial spasm, etc.
Unarmed localization (Touching, reverse traction)	Economical, convenient, fast, reducing pain caused by EMG and dislocation due to miscoordination	Deep and small muscle which was unreachable	Limbs, superficial muscle group e.g. biceps muscle of arm, adductor etc.
Ultrasound	Good identification between injection sites (muscle, gland) and their surrounding structures. Precise location for diagnosis and prevention of error in injection	High cost (including facilities and professional technical training)	Salivation casued by cerebral palsy, Parkinson's disease and amyotrophic lateral sclerosis, salivary gland, parotid gland and other muscles.
Gait Analysis	Provide data of kinematics for research use	Require lots of space, manpower and resources, high level facilities	Complex movement disorders

Different techniques have their own advantages. They are complementary to each other. For myography, by measurement of motor potentials of the muscle groups, site of muscles which are weak, spastic and undergo cocontraction can be determined. Concentric needle electrode helps to determine locations, and decreases injection sites, the occurrence of injection errors and spread to non-target muscles. Myography is now generally used in clinical research. However, it is not an ideal method for special

groups such as children and people with cognitive impairment due to its poor coordination.

3.2 Ultrasound is paid attention as it becomes a new muscle localized injection technique. It causes no pain and is non-invasive. The frequency range in medical use is 2-10 MHz. The ultrasound imaging of neurovascular was presented as follows. Artery showed rhythm with no echoes while vein constricted with echoes. Round or oval-shaped zones with low echoes were surrounded with high echoes at the transverse side of nerve. Non-successive low-echoed lines were found longitudinally. There were separated high-echoed lines. Bone was presented as shiny high-echoed periosteum with shadow at the back. Muscle was low-echoed and tendon was shown as cylindrical high-echoed lines (fibrous). Fascia was high-echoed. Because of the high resolution of high-frequency ultrasound, target muscles and the surrounding neurovascular were clearly seen. The Doppler's ultrasonic diagnosis apparatus used could meet the requirement. With the help of the machine, injection needles were inserted into muscles specially deep-level muscles accurately. Target muscles were reached while the surrounding blood vessels and nerves were kept away from. For the injection at tibialis posterior, needles are mostly inserted from the posterior side of lower leg by the localization of myography and electrical stimuli. Since tibialis posterior is at the third layer of ischiocrural and is closely adjacent to posterior tibial artery and tibial nerve, blood vessels are easily pierced. With the guidance of ultrasound, needle is inserted by the side of tibia from the anterior lower leg so that the needle can be kept away from posterior tibial artery and tibial nerve and enters tibialis posterior precisely.

3.3 In order to have the precise localization, the clinical professions have to be familiar to the clinical features of spasm and dysfunctions caused. The ultrasound professions should be familiar to the anatomy and the kinematics of the muscles at the injection sites. Upper and lower limbs muscle localized atlas for LANTOX injection are made according to the anatomy atlas and related research articles. The features of localized atlas are shown as below.

3.3.1 All muscle groups at upper and lower limbs are covered in the local atlas. The corresponding involved muscles for limb spasticity after upper motoneuron injury can be found in the atlas.

3.3.2 The affected muscles were shown from the anterior, lateral, posterior and cross-sectional side views. Cross-sectional tissue structures are mostly presented by

ultrasound. Being familiar to the anatomy in the relations is helpful in guiding localization. Green points were indicated as the injection sites. Localization could be done with the help of the atlas to observe the muscle anatomy and its dynamic changes.

3.3.3 The clinical manifestations of the muscle spasm were compared to the dysfunctions. Besides the pictures showing the clinical features, descriptions of the corresponding dysfunctions were shown at the atlas. It was of vital importance to have an accurate diagnosis in the involved muscles.

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