Immediate Effect of Acupuncture on Poststroke Patients
with Spastic Upper Limb Hemiparesis

Ana Rita Rebelo Tavares Rodrigues

Dissertação de Mestrado em Medicina Tradicional Chinesa

2014
Immediate Effect of Acupuncture on Poststroke Patients with Spastic Upper Limb Hemiparesis

Dissertação de Candidatura ao grau de Mestre em Medicina Tradicional Chinesa submetida ao Instituto de Ciências Biomédicas de Abel Salazar da Universidade do Porto

Orientador
Prof. Doutor Henry Johannes Greten
Categoria – Professor Associado
Afiliação – Instituto de Ciências Biomédicas Abel Salazar

Co-orientador
Maria João Rodrigues dos Santos
Categoria – Professor Associado
Afiliação – Instituto de Ciências Biomédicas Abel Salazar
Dedication

To my parents and Tiago.
“All human knowledge begins with intuitions, proceeds from thence to concepts, and ends with ideas.”

*Immanuel Kant*
Acknowledgements

To my family for all that I am.

To Tiago for all the support and care.

To Professor Greten for all the knowledge it conveys.

To Maria João, for always have believed in me.

To Professor Jorge Machado for his scientific enthusiasm.

To Prelada's Hospital department of rehabilitation, in particular to Dr. Gonçalo Borges and D. Corina, for the partnership.

To all new friends of this master and specialization, for the companionship in this journey.

To all the participants that made this study possible.
Resumo

Introdução: O acidente vascular cerebral é a principal causa de incapacidade a longo prazo em todo o mundo. A espasticidade, como uma sequela recorrente após acidente vascular cerebral, pode ser muito prejudicial para as actividades da vida diária e na qualidade de vida dos utentes. Neste estudo, relatamos sete estudos de casos de espasticidade após acidente vascular cerebral tratados pelo modelo de Heidelberg de Medicina Chinesa.

Objetivo: O objectivo deste estudo foi avaliar o efeito imediato da acupuntura na espasticidade dos flexores do cotovelo em pacientes com hemiparésia secundária a acidente vascular cerebral, analisando o impacto na escala Ashworth modificada, nas amplitudes de movimento e na quantificação física da força necessária para realizar passivamente extensão do cotovelo do paciente.

Métodos: Sete pacientes (3 homens e 4 mulheres), com idade de 60 (± 14) anos de idade, com hemiparésia espástica foram incluídos com uma média de 63 (± 59) meses após o acidente vascular cerebral. Na linha de base, antes da intervenção, as medições incluíam: (1) o grau de flexão do cotovelo em repouso, (2) a amplitude de movimento activo do cotovelo, (3) o intervalo de movimento passivo do cotovelo, (4) avaliar a força necessária para atingir 10 graus de extensão do cotovelo, a uma velocidade lenta, e (5) avaliação com a escala de Ashworth modificada (MAS). Os participantes receberam uma única intervenção de acupuntura com recurso à técnica leopard spot no PC6, IC10 e o seu respectivo contra-ponto no conduto pulmonar (P5') no membro superior lesado, em combinação com os pontos H2, S44 e L4 no membro inferior não afectado. Após a intervenção todos os parâmetros foram reavaliados.

Resultados: Em todos os participantes, o ângulo de flexão do cotovelo em repouso diminuiu, em média, 5,9 graus. Com excepção de um participante que não tem qualquer tipo de movimento activo no cotovelo, todos os restantes participantes aumentaram a amplitude de movimento activo, em média, 11,9 graus. Em 5 dos 7 pacientes houve uma diminuição de 1,96 Newton da força necessária para estender o cotovelo 10 graus. Apesar de ser uma avaliação de um efeito imediato, foi possível verificar diferenças na MAS em 3 participantes. Devido ao tamanho da amostra abstivemo-nos de avaliação estatística.
Discussão: Existem muitas abordagens para a espasticidade - fisioterapia, tratamento medicamentoso, toxina botulínica, electroterapia e, em último caso, intervenção cirúrgica. Embora existam inúmeras abordagens para o tratamento da espasticidade, muitos pacientes ainda são incapazes de encontrar um método satisfatório, com efeitos colaterais aceitáveis. No desenvolvimento de um plano global de tratamento, deve considerar-se que os objectivos do tratamento, incluindo o equilíbrio entre a redução da espasticidade e preservação da força motora residual e função. A limitação deste estudo prende-se à falta de um grupo de controlo e ao tamanho reduzido da amostra; no entanto mostra algum tipo de resultado imediatamente em todos os pacientes.

Conclusão: Se provado ser eficaz, a acupuntura pode ser uma terapia complementar para o tratamento de espasticidade, com baixos efeitos colaterais, de aplicação rápida e de baixo custo. Uma pesquisa adicional, com uma amostra maior, é necessária para avaliar os efeitos a longo prazo da acupuntura no espasticidade após acidente vascular cerebral. Nosso estudo está ainda em curso, contribuindo para tal uma amostra maior.

Palavras-chave: Acidente Vascular Cerebral; Espasticidade; Acupuntura; Medicina Tradicional Chinesa
Abstract

**Introduction:** Stroke is a major cause of long-term disability worldwide. Spasticity, as a recurrent post-stroke sequel, can be highly detrimental to daily functioning and quality of life. We report 7 individual case studies of post-stroke spasticity treated by the Heidelberg model of Chinese medicine.

**Objective:** The aim of this study was to evaluate the immediate effect of acupuncture in spasticity of the elbow flexors in hemiplegic stroke patients, analyzing the impact on the modified Ashworth scale, on amplitude changes and by an objective physical quantification of force necessarily to extent passively the patients elbow.

**Methods:** Seven patients (3 male and 4 female), mean age of 60 (±14) years, with spastic hemiparesis were included with a mean of 63 (±59) months after stroke. At the baseline, before intervention, measurements included: (1) the degree of flexion of the elbow at rest, (2) the range of active motion of the elbow, (3) the range of passive movement of the elbow, (4) evaluating the force required to achieve 10-degree elbow extension, at a slow rate, and (5) measure of spasticity with the Ashworth scale. Participants received a single acupuncture intervention with leopard spot technique on Pc6, Ic10 and the pulmonary counter point of Ic10 (P5’) in the hemiplegic arm, in combination with H2, S44 and L4 in the non-affected side. After the intervention all parameter were re-evaluated.

**Results:** In all the participants, the angle of elbow flexion at rest position decreased on average 5.9 degrees. Except for one participant who did not have any kind of active movement at the elbow, all remaining participants increased the range of active movement in average 11.9 degrees. In 5 of the 7 patients there was a decrease of 1.96 Newton needed to extend 10 degrees the elbow. Despite being an assessment of an immediate effect it was possible to verify differences in the MAS in 3 participants. Due to the sample size we refrain to statistical evaluation.

**Discussion:** There are many approaches to spasticity – physical therapy, drug treatment, botulinum toxin injection, electrical treatment and, at the borderline surgical intervention. Although there are numerous approaches to the treatment of spasticity, many patients are still unable to find a satisfactory method with acceptable side effects. In the development of an overall treatment plan, consideration should be given to the treatment goals, including the balance between reduction of spasticity and preservation of residual motor
strength and function. The short coming of this pre-study is the lack of controls and the low sample size; the strength of the study is that it shows immediately results in all patients.

**Conclusion**: If proven to be effective, acupuncture may be a complementary therapy for the treatment of spasticity, with low side effects, fast application and low cost. Additional research, with bigger sample, is needed to evaluate long term effects of acupuncture on spasticity after stroke. Our study is still ongoing and may contribute the necessary sample size of a bigger experiment.

**Keywords**: Stroke; Spasticity; Acupuncture; Traditional Chinese Medicine.
List of Abbreviations

ALT – Algor Laedens Theory
H – Hepatic
HM – Heidelberg Model
Ic – Crassintestinal
L – Lienal
MAS – Modified Ashworth Scale
N – Newton
P – Pulmonal
Pc – Pericardiac
PS – Post Stroke
S – Stomach
TCM – Traditional Chinese Medicine
## Contents

1. **Introduction** ........................................................................................................................................................................ 13

2. **Stroke, Cerebrovascular Accident – a global pathology** ........................................................................................................... 13
   2.1 Epidemiology, Risk Factors and Socioeconomic Impact .......................................................................................................... 14
   2.2 Stroke and Spasticity ............................................................................................................................................................ 14
   2.3 Physiopathology of Upper Motor Neuron Syndrome ............................................................................................................ 16

3. **Traditional Chinese Medicine Overview** ............................................................................................................................. 17
   3.1 Acupuncture ......................................................................................................................................................................... 18
   3.2 Heidelberg Model ............................................................................................................................................................... 18
      3.2.2 Pathogenesis in TCM ...................................................................................................................................................... 23
      3.2.3 Consequences of Yin Deficiency .......................................................................................................................................... 24
      3.2.4 Algor Leadens Theory ....................................................................................................................................................... 24
      3.2.4 Stroke According HM Chinese Medicine .......................................................................................................................... 27
   3.3 Rehabilitation Techniques on Post-Stroke Spasticity ................................................................................................................... 29
      3.3.1 Physical Treatment .......................................................................................................................................................... 29
      3.3.2 Electrical Stimulation ......................................................................................................................................................... 30
      3.3.3 Pharmacological Management ......................................................................................................................................... 31
      3.3.4 Surgical Intervention ......................................................................................................................................................... 32
      3.3.5 TCM Approaches ............................................................................................................................................................. 33

4. **Clinical Research Protocol** ...................................................................................................................................................... 33
   4.1 Organizational Structure ......................................................................................................................................................... 33
   4.2 Research Team ....................................................................................................................................................................... 34
   4.3 Study Objectives ..................................................................................................................................................................... 35
      4.3.1 General Objectives ......................................................................................................................................................... 35
      4.3.2 Specific Objectives .......................................................................................................................................................... 35
   4.4 Study Design ............................................................................................................................................................................ 35
   4.5 Participants ............................................................................................................................................................................. 35
   4.6 Instrumentation ..................................................................................................................................................................... 36
      4.6.1 Universal Goniometer ..................................................................................................................................................... 36
1. Introduction

Every year, 5 million people worldwide stay permanently disable due to stroke. Spasticity is a major symptom in post-stroke patients and it can have a disabling effect through pain and reduced mobility, which may limit the potential success of rehabilitation. Spasticity can also affect quality of life and can be diverse and highly detrimental to daily functioning (1).

Clinically, one of the goals of management of stroke patients should be to reduce spasticity, but, there are lacks of specific guidelines for the stratification and individualization of rehabilitation programmes on that condition (2) (3). As in these cases, the potential of physiotherapy rehabilitation is limited becomes essential the use of complementary therapies such as acupuncture, a valid treatment in the stroke squeals. In fact, among the conditions recommended by the WHO in 1979 as treatable by acupuncture was already post-stroke paralysis (4).

This study will explore a different approach by the Heidelberg Model of Chinese Medicine that attempt to act on elbow spasticity caused by a stroke.

2. Stroke, Cerebrovascular Accident – a global pathology

Stroke is the commonly term for the medical condition of a cerebral vascular accident, a non-communicable disease, caused by the interruption of the blood supply to the brain, usually because a blood vessel bursts or it is blocked by a clot. This cuts off the supply of oxygen and nutrients, causes damage to the brain tissue. Clinically there are two types of stroke, based on separated pathomechanisms – ischemic and hemorrhagic (5). The first one is generally referred to a cerebral infarction, where a blood clot obstructs a vessel, with 60% of all strokes falling under this category. The cerebral hemorrhage of a vessel occurs for about 20-30% of stroke cases. The most common symptom of a stroke is sudden weakness or numbness of the face, arm or leg, most often on one side of the body. Other symptoms include: confusion, difficulty speaking or non understanding speech; difficulty seeing with one or both eyes; difficult walking, dizziness, loss of balance or coordination; severe headache with unknown cause; fainting or unconsciousness. The effects of a stroke depend on which part of the brain is injured and how severely it is affected, and it can even cause sudden death (6) (7).
2.1 Epidemiology, Risk Factors and Socioeconomic Impact

According to the World Health Organization, each year 15 million people suffer stroke worldwide. Of these, 5 million die and another 5 million stay permanently disabled. It constitutes the third leading cause of permanent disability in developed countries. Europe averages approximately 650,000 stroke deaths each year (8) (7). In Portugal, stroke’s impact is even greater, with high mortality in working age (under 65 years). Although mortality has been declining over the past decades, this disease appears as a major cause of long-term disability (9).

Increasing age, high blood pressure, cholesterol, overweight, low fruit and vegetables intake, physical inactivity, smoke, alcohol, structural heart disease, history of stroke, transient ischemic attack or systemic embolism and diabetes mellitus, increase clearly the risk of stroke. High blood pressure contributes to more than 12.7 million strokes worldwide. (8) (10). In developed countries, the incidence of stroke is declining, largely due to efforts to lower blood pressure and reduce smoking. However, the overall rate of stroke remains high due to the aging of the population (8). By the year 2020, stroke and coronary-artery disease together, are expected to be the leading causes of lost healthy life-years (5).

As a chronic and severe disease, stroke has an enormous emotional and socioeconomic impact for the patients, their families, and health services, especially in an increasingly aged population. The future planning and intervention goes through a focus on primary and secondary prevention (11).

2.2 Stroke and Spasticity

Motor deficits are the most common impairment after acute stroke and persist in nearly half of all patients (12). Despite the sequels vary depending on the severity and location of the injury, spasticity is a common and major problem of stroke rehabilitation, that together with other signs and symptoms result in functional problems that can predispose to costly complications (3) (13).

The word "spasticity" is derived from the Greek word spasticus, which means "to pull or to tug" (14). Lace in 1980 was the first to describe spasticity as a "motor disorder
characterized by a velocity dependent increase in tonic stretch reflexes (muscle tone) with exaggerated tendon jerks, resulting from hyperexcitability of the stretch reflex, as one component of the upper motor neuron syndrome”. He does not take into account the repercussion on voluntary movements, and in 1994 Young defined as a “motor disorder characterized by a velocity-dependent increase in tonic stretch reflexes that results from abnormal intra-spinal processing of primary afferent input” (2). A more recent definition (2005), superseded the Lance definition and described “a disordered sensori-motor control, resulting from an upper motor neuron lesion, presenting as intermittent or sustained involuntary activation of muscles” (1). There is thus no correct and universal definition, which partly reflects the complexity and the diversity of the phenomena. Spasticity can induce in patients symptoms of pain, ankylosis, tendon retraction or muscle weakness, which may limit the potential success of rehabilitation, affect quality-of-life and be highly detrimental to daily function (2).

Spasticity after stroke occurs in about 30% of the patients; however the onset of the symptom is highly variable and can occur in the short-, medium- or long-term post-stroke period (1). Another study reported that 39% of patients with first-ever stroke are spastic after 12 months (15). The initial paresis after stroke is due to the acute onset of the lesion, neuron destruction, edema, decreased circulation and possible increased inhibitory activity that protects the brain against further damage. A gradual return of reflexes and motor activity is related to resolution of edema and necrotic tissue, as well as initial reorganization of the central nervous system (16). For instance, stroke affecting the motor cortex or internal capsule commonly produces initial hypotonia and absent tendon jerks, followed several days or weeks later by spastic hypertonia in the antigravity muscles (17). Wissel et al. observed that spasticity primarily affects the elbow (79% of patients), the wrist (66%) and the ankle (66%). Spasticity is more frequent in the upper than the lower extremities and most frequent adopts a pattern of spasticity with internal rotation and adduction of the shoulder coupled with flexion at the elbow and the wrist and the fingers flexed into the palm (18) (17).

The exact influence of spasticity on motor impairments and activity limitations in stroke patients is difficult to assess because the degree of spasticity may change according to the position of the subject and the task being performed (15). The resistance associated to spasticity not only makes the movement more difficult. Commonly the patients are unable to generate sufficient tone against gravity, and also cause the muscle to remain in a shortened position, leading to further hypertonicity and adaptive shortening (19).
Spasticity is difficult to quantify and is not universally understood to be the same by everyone. Altered muscle tone, weakness and incoordination, along with adaptive changes in muscle, soft tissue and their alignment, will all impact on the ability to recover efficient movement and will limit function in a patient after stroke (19). Large randomized double blind placebo controlled trials are very difficult to implement in the rehabilitation field, mostly when speaking at such dependent variable such as spasticity (20).

2.3 Physiopathology of Upper Motor Neuron Syndrome

Spasticity is one part of the upper motor neuron syndrome. The upper motor neuron syndrome involve all the decontrol characteristics associated with a lesion affecting the descending motor pathways and has two classical distinctions in terms of signs and symptoms, the positive and negative features (12) (15). The negative components of the syndrome are characterized by a reduction in motor activity as a direct result of the lesion itself (weakness, loss of dexterity and fatigue), whereas the positive phenomena are associated with symptoms that demonstrate an increased in motor activity, related to the secondary changes, characteristics that are not normally present and mainly connected to the reorganization of the central nervous system. Positive features include increased tendon reflexes with radiation, clonus, dyssynergic patterns of co-contraction during movement, associated reactions, abnormal postures and spasticity. This classification does not integrate cognitive dysfunctions or psychological reactions (16) (19).

Upper motor neurons include supraspinal inhibitory and excitatory fibres, which descend from the primary motor cortex of the cerebrum and possess long axons forming corticospinal and corticobulbar tracts, doing a balanced control on spinal reflex activity (1) (21). The main tract that inhibits spinal reflex activity is the dorsal corticoreticulospinal tract, the parapyramidal tract, which arises in the ventromedial reticular formation. The parapyramidal is accompanied by the lateral corticospinal, or pyramidal tract, that runs very close to it (Figure 1). Thus a single lesion frequently affects both tracts. Positive and negative features of UMN syndrome, is largely due to parapyramidal fibre dysfunction, the pyramidal tract lesion makes a small contribution, indeed isolated lesions of the pyramidal tract do not cause spasticity. The excitatory pathways also arise in the brain stem. The most important are those arising in the bulbopontine tegmentum and descend in the medial reticulospinal tract. The vestibulospinal fibres also have an excitatory effect, but as
they are separate from the other excitatory pathways do not seem to be as important in the production of spasticity (Figure 1) (21).

![Figure 1](image)

Figure 1 Descending pathways controlling spinal reflex excitability. Inhibitory fibres shown in gray, excitatory in black (21)

The unbalancing of an otherwise stable equilibrium between inhibitory and excitatory fibers can result in a mixing of complex and diverse clinical syndromes, and lesions occurring in a certain area may have different effects on different patients (1). Although the location of the lesion plays a role in determining the character of the spasticity, further sensory input provokes a greater spasticity manifestation. These patterns are also dependent upon the time after the lesion. Typically, immediately after a stroke, there is a period of shock, with depression of reflexes. The onset of spasticity is likely to be dependent on neuroplasticity of the nervous system (1) (21).

3. Traditional Chinese Medicine Overview

Officially, Chinese Medicine starts with the first written reference called the Yellow Emperor’s Inner Classic (Huangdi Neijing) that is believed to date back more than two thousand years. However, archaeological findings have revealed that acupuncture needles
and traces of herbal treatment has been used for 4000 to 6000 years ago (22). The Yellow Emperor's Inner Classic is the most important text in the literature of traditional Chinese medicine, which laid its foundation. In the form we know today (from the 13th century) the book comprises two volumes: “Basic Questions” and “Divine Pivot”, which introduced the yin-yang theory, the Five-Element theory, and the Channel-Collateral theory that form the basis of traditional Chinese medicine. After more than 2000 years, this knowledge has spread far beyond China (23). In Europe, this method of treating patients by the insertion of needles with therapeutic proposes first became known in 1658 (22). In Portugal, acupuncture has developed in medical circles, mostly in the latter seventies of the last century. In a increasingly globalized world, traditional Chinese medicine has spread far beyond China, and part of this is due to the fact that conventional medicine and Chinese medicine does not compete with each other, on the contrary they are complementary (24).

3.1 Acupuncture

Acupuncture therapy was the first aspect of Chinese medicine to have become known in the west. A vital energy – qi ¹ – flows in the tissue under the skin along topographically defined lines known as channels or conduits. This flow of within the body is accessible from the outside via certain entries in the skin; the acupuncture points, and the aim of acupuncture is to activate that inner energy potential. Acupuncture as it is often practiced in the west no longer has much in common with the traditional concept. This new form of acupuncture therapy is built on a western view of the world with the transformation of complex phenomena in measurable data (22).

3.2 Heidelberg Model

The Heidelberg model of Chinese Medicine is a rational model that explains the general laws of classical TCM integrated with the current knowledge of human anatomy, physiology and pathology, thereby unifying the contemporary medic-scientific knowledge,

¹ “Vegetative capacity to function of a tissue or an organ which may cause the sensation of pressure, tearing or flow” (25).
with concepts of different schools of Chinese medicine. This model of neo-Chinese Medicine is a novel of vegetative medicine.

Like all kinds of medicines, the Chinese interprets symptoms, and to their eyes the most important postulate in describing the world (and thus also the symptoms) is based on yin and yang – two opposite sides of the same reality. There is a dynamic equilibrium between those opposites and the reality is seen as a manifestation of this interaction (25).

All procedures of the world consist of ups and downs along the time, describing circular function that can be represented in a sinus wave (Figure 2). The sinus wave can be used to describe human functions in the sense of the periodicity of homoeostasis. Yin and yang form that sinus wave, and it can be interpreted as a mathematical expression of numbers, 1 and 0. From the combination of 1 and 0 we can use the bigrams to symbolize the quarter section of the circular movement – Wood, Fire, Metal and Water – the phases. In the course of the sinus wave there are points of transition from one phase to the other. These transitions should be clear. They must allow that the power of the movement can be processed to the next phase, and it is represented by Earth (25). Extending the numbering system from a bigram to a trigram means that the circle can be also defined in eight parts. One phase normally contains two circles of sings – one eight of a circle represents one orb (group of diagnostically relevant signs) (25).

![Sinus wave as a projection of the compass rose](image)

**Figure 2** Sinus wave as a projection of the compass rose (26)

In the body, the yang is a term which refers to all activity possible, derived from the functional tissue, the yin. In a state of health, there is a harmonious balance between yin (structure, substance) and yang (function), a balance between ascending and descending vectors of human regulation (homeostasis). They are physiological aspects of the body.
Yang represents the driving force for activities, warmth, and lack of fluids. Yin represents deep rest, cold, dampness and it nourishes the tissue. In the yang phases sympathetic functions are more dominantly present; in the yin phases are the parasympathetic functions that are relatively more present (Figure 3) (26).

Figure 3 Yin and Yang and the phases with the correspondent vegetative state
The clinical indicator signs are postulated to be caused by body regions and to indicate the functional state of a body region, or body island. It allocates regulatory states, to organ names, not in terms of western physiology, but to neuro-emotional patterns caused by the vegetative system (25).

In the phase wood, the hepatic (liver) orb brings the yang upward. This movement includes functions like more vigilance (in the morning this movement takes place and produces awareness). Beyond this natural functions, if the this movement is too strong, can cause for instance, hypertension, and over-alertness due to stress. As seen in the figure 3, the wood phase correspond to sympathetic functions predominance such as hypertone. By that we can already assume that might be some connection of phase wood with the clinical cases of post stroke spasticity. The cardiac orb (the heart) is the source of original qi of the phase fire to which also the xue\(^2\) belongs. The pulmonary (lung) orb, in the metal phase, brings the qi down, a state of de-activation. In the water phase, the phase of regeneration, the renal orb (kidney) represents the function of the yin, the cellular apparatus of the body with the function of regeneration (26) (25).

Beyond the orbs that we spoke above (the intimal orbs, that have the same direction of the respective phase), there are the external orbs respectively, which slow down the qi flow in the phase, and must be balanced with the internal. Thus there are also for phase wood, the felleal orb (gall blader); for fire, the tenuistestinal orb (small intestine), as well as, pericardiac (internal) and tricaloric (external), as fire is the only phase that has four orbs; for metal phase, the crassintestinal (large intestine) orb, and for water, also the vesical (bladder) orb. The centre is represented by the external orb, the stomach, and the internal, the lienal orb (the spleen) (26) (25).

Basic body regulation is analogous to a thermodynamic system, for instance the regulation of a water basin (Figure 4). In this system, there is an electric heater which is regulated by a thermostat, at a target temperature; 37°C. When we turn on the heater it takes some time to reach the pretend temperature. When the target temperature has been reach, the thermostat turn off the heater, but the afterheat that persist causes a peak of temperature (phase I on figure 4). The excess of heat is gradually used up, and the water gets back to 37°C the system will turn on again (phase II on figure 4). The third phase, correspond to a period of latency, until the heater gets hot again; and at fourth the procedure happen in a repetitive manner. The regulation model of the water basin can be

\(^2\) Xue ("blood") is a “form of functional capacity ("energy") bound to body fluids with functions such warming, moisturizing, creating qi and nitrifying a tissue” (25).
applied to the model of phases – wood, fire, metal and water – being the target value (37°C) the centre, the earth that exerts a down-regulation in the first half of the movement, and up-regulation in the second half of it. Regarding to the phases, being the Centre, it has functions of assimilation and transformation, so that the continuum of the equilibrium is kept (25).

![Figure 4 The water basin regulation theory (25)](image)

Greten has defined HM medicine as “a system of sensations and findings designed to evaluate the functional vegetative state of the body”. This state may be treated by 6 therapeutic disciplines: phytotherapy (Chinese pharmacology), Qigong (biofeedback neurovegetative exercises), dietetics, Tuina (Chinese manual therapy), acupuncture and psychotherapy (25).

3.2.1 Diagnosis

The diagnosis in traditional Chinese medicine has four distinct parts: the constitution; the agent; the orb and the eight guiding criteria. In the first step, the constitution, is defined
the inner nature of the patient, based on his phenotype, body language and communication. The second step, the agent (so-called pathogenic factor) is regarded as a functional power that causes changes in the functional properties of the individual. The agents can be divided into those that come from the exterior, (ventus, algor, ariditas, aestus, ardor), from the interior (by emotions) and neutral (bad nutrition, accidents, inter alia). The third step, the orb refers to groups of diagnostically relevant signs indicating the functional state of a body region where some of the symptoms take place, which correlates with the functional properties of a conduit. The last step, the eight guiding criteria, is an interpretative approach of body regulation in different levels. The first level, as a neurovegetative regulation – repletion (“fullness”) and depletion (“emptiness”); second as an humoro-vegetative regulation – calor (“heat”) and algor (“cold”); third as a neuro-immunological regulation – extima (“exterior”) and intima (“interior”); and fourth as a structural or regulatory deficiency – yin and yang (25).

3.2.2 Pathogenesis in TCM

A phase is a vegetative tendency, and normally, there is a continuous change and transformation of one phase and their manifestation (an orb) into the next. This is called as a continuum of functions, in which all the specific signs that can appear by daily constant interactions with the environment disappear. When the functional continuum is disrupted, the dominance of a sign becomes a critical symptom. The pathological manifestation can be due to (25):

- Problems of transition – the phases, should be clearly processed one into to the other in order to maintain the orthopathy\(^3\). Occasionally there is a lack of transformation in the body and the circular function is blocked, and resulting in pathological signs of the blocked vector (phase);
- Excess of an agent – if an agent is continuously present, the related phase is also continuously over-initiate;
- Imbalance of antagonists – when there is an imbalance of antagonists, one of the phases will be in excess in relation to the other, leading to a predominance of their signs;
- Yin deficiency – referring to the regulatory curve of thermoregulation in the water basin, assuming that we lower the among of water in the basin to one half, the

\(^3\) Latin word for “running straight”; state of eu-regulation and the capacity to restore that state (25).
temperature will rises and decrease the double (Figure 5). So, a lack of substance (yin) causes an extreme course of the regulatory sinus wave and it leads to a labile qi.

![Figure 5 Labile qi regulation due to yin deficiency](image)

### 3.2.3 Consequences of Yin Deficiency

The labile qi present in cases of yin deficiency, challenge the centre - stomach and lienal orbs - to restore the orthopathy, the target value, by down- and up-regulation. This challenge over time may lead to (25):

- Pathologic Ascending – uprising yang, ardor vigens or internal ventus;
- Yang deficiency – lack of upward movement.

### 3.2.4 Algor Leadens Theory

*Algor Laedens Theory* (ALT) is the Latin name of *Shang Han Lun* (treatise on cold damage diseases) systematically introduced regular pattern of diagnosis for diseases due to invasion of exogenous pathogenic factors. This theory considers that an agent faces six levels of defense when invades the body. These six levels of defense differ in vegetative functional capacity qi and xue. The stages, ALT levels, are characterized by specific
clinical signs that will help to identify on what level of defense lies the pathogenic agent, and therefore to classify the capacity of damage on the body. The first level of defense is the $qi$ defensivum and is related to Tenuintestinal and Vesical conduits, that depend very much on the status of $xue$. So, the lack or decrease of microcirculation (algor) will be the prime cause of the invasion of agents. By the western overview this theory assesses the reaction process of the body to the presence of an agent. It reflects the absence or decrease of the microcirculation which affects first the conduits that contain more $xue$ than $qi$. The ALT allows us to interpret the third guiding criteria, extima/intimate. As the stages I, II and III are outside the body region, and are constituted by yang conduits, their names contains termination yang. On the other hand, the stages IV, V and VI, are directly related to the body region, constituted by yin conduits, internal and contains the term yin. Due to its relative importance in post-stroke rehabilitation is important to point out stage II, IV and V (Figure 6) (25).

The stage II ($splendor$ $yang$), is when an agent blocks the $qi$ of the conduit, and the reactive calor reaches its highest point and is the symptomatic leading. The $qi$ flow is blocked more easily than the $xue$ flow, because “$qi$ moves the $xue$”. So in this stage, the orbs affected are those that are more dependent on $qi$ – the stomach and the crassintestinal. The body then activates the $xue$, forming calor from the interior, up to a maximum, to wash out algor out of the conduits. This primarily results in algor-related pain and reactive calor, and secondarily in functional disorders of the respective orb (25).

- Stomach Orb: “all depletion is a depletion of the centre”, is a known expression of TCM, indicating that the centre in every deregulation is challenged, and therefore prone to lack of $qi$. The external conduit of earth, the stomach is easily affected in this stage (25) (27).
- Crassintestinal Orb: depletion, as seen in the sinus wave, may lead to signs of the phase metal, as this phase is depletive in nature and has a downward direction. This is why the external conduit of this phase, is so easily affected on this stage. There are two big types of energy, the respiratory and nutritive $qi$, this last one is guided by the IC orb. It’s the advancing mechanism of nutrition, cause helps to distribute nutrition as an energy form by the rhythmic capacities of metal. It has also a rhythmic action on the intestines, necessary to bowel functions (25).

Stage IV ($yin$ $major$): body island $qi$ is affected, which is the $qi$ within the intima, a general name for the whole body’s interior, where the functions of the orbs are generated in the respective parts of the body. When a agent affects the $qi$ of the body islands, the
lienal and the pulmonary orb are more prone affected, as the centre and metal are sensitive to diminished activity of qi (as seen on stage II) (25).

- Lienal Orb: belongs to the phase earth and has a upward direction, so there’s the connection to the strong influence on the connective tissue, as one of the main functions of lienal is “hold the flesh” (25).

- Pulmonary Orb: muscular tone changes with the rhythm of breathing; breath out reduces the tone in the muscles of the back, and breath in enhances the tone. That fact depends that the functional capacity of the tissue depends on the blood supply, and therefore good breathing is an essential part of activating body functions. Also, the rhythmic activity of breathing is adapt to the rhythm of body flow, and moreover the capillary flow within the superficial tissue of the skin and membranes is sensitive of breathing too. Chinese medicine also believe that breathing out has a clearing effect on the conduits flow, that can rinse off pathogenic factors and clearing emotions (26).

Stage V (yin flects): the yin decreases, is vanishing, and the agent reaches the body island xue which is a substantial part of the body islands with warming, thus functionally activating and enhancing properties. If the xue is affected by algor, this is the lowest point of energy, that is why this phase is called the “flat-down” phase. Xue can even be used up by this process, resulting in a lack of yin (25).

- Hepatic Orb: the hepatic orb is considered to be the mare xue (“sea of blood”), and controls the movement of xue, and is associated to signs and symptoms due to a lack of control of excitation and initiation (27).

- Pericardiac Orb: the acting out potential (phase fire) does not only produce emotions e associations (related to the cardiac orb), but also produces drive. This drive of personality is controlled by the pericardiac orb, and it also works for the pump of activating powers in the body. One of the most prominent pericardiac signs are the palpitations and the difference of disturbances in emotionality and drive (like a bipolar depression) (26).
3.2.4 Stroke According HM Chinese Medicine

The systematic approach to neurology by Chinese medicine can be divided into five groups of theoretical considerations (27):

1. The cerebral paraorb (signs and symptoms related to the general functions associated to the brain) belongs to the renal orb, phase water, the phase of regeneration and geriatrics.

2. Fine and higher nervous control of cerebral functions are cardiac (which is the counterpart of the renal orb). Shen, the ability and the power to create coherence of perception, coherence of speech, fluent fine motorics and a primary order of emotions, belong to cardiac functions.

3. If the renal orb is not well balanced with the cardiac then may be seen wood signs, such as ventus internus or spastics – water becomes wood by repletion, too much energy (1st guiding criteria). In terms of the 4th guiding criteria, deficiency of water (yin) creates uprising yang (the water basin theory of regulation) in its three forms, one of them is ventus internus. Here it’s useful to use points against uprising yang, such as H3, H2 and other effusories.
4. Yang deficiency causes lack of upward movement, and may lead to lack of wood and lack of centre functions.

5. Algor (in the 3rd guiding criteria, the model of six stages – ALT), as a consequence of yang deficiency, leads to a regional lack of xue in the limbs. Also, lack of lineal function leads to disturbances of qi flow in the limbs. Palsy often shows limited qi flow in the limbs. Algor leads to lineal deficiency and this again to stomach deficiency, resulting in a tendency to express splendor yang (stage II) or yin major (stage IV). Under this condition, is essential to supplete the qi of stage II and IV; supplete and move the xue (to go to the cold areas, and warm the limbs) and to warm the centre and expel pituita.

In neurology the major cause of spastic palsy is internal ventus, as a form of uprising yang due to yin deficiency, or caused by the hepatic orb. The principle of the action of ventus is to block the reticulares (pathways of communication between conduits), and at the same time the tissue is activated as ventus is a yang agent. Instead of becoming weak, like by yin agents (e.g. algor) the tissues become over-activated, even warm or spastic. Therefore, spastic palsy requires liberating of reticulares by blood leating of the puteals or the effusories. For systematic reasons reduce the phase wood, such as by H2 or H3. In addition, by the contribution of the post-traumatic algor, not only hepatic, but also pericardiac is prone to reduce spasticity. Common combination includes H2 and Pc6 according to ALT, and by the dominance of phase wood, that frequently induces wood-earth imbalances, is also useful to combine also S44 (26).

To the eyes of Chinese medicine, the understanding of stroke can be divided into the acute stroke and the status after stroke. The first one is seen as a result of ascending movements of yang predominantly in the upper caloric, due to a yin deficiency; the condition after stroke is regarded as a post-traumatic algor in co-existence with yang deficiency (28) (6).

For the diagnostics of neurological symptoms there are two major rules. The interpretation of neurologic deficits, as a consequence of algor, and that requires the application of the ALT; and as symptoms of ventus. Neurological diseases can be described in terms of the ALT, or by the phases. Described by phases, water, the yin, is deficient, and therefore yang is instable, which may lead to internal ventus, or flaccidity (no muscular strength). These symptoms come from too much wood, or not enough wood, and this is why most of the neurological symptoms is an instability of the phase wood. Wood has to be balance with earth, and thereby in these conditions the earth (stomach descending energies) may be over-challenged in counterbalancing. Calor belongs to the phase wood and therefore it would be logical to say that a wood-earth imbalance in the
language of phases resembles calor-stomachi. The chronification in terms of ALT is that calor, in the splendor yang (stage II) produces yin deficiency; or we can say that yin deficiency (water) produces instable calor, which affects the stomach orb. The difference is the course of the disease. In many diseases flaccid palsy is accompanied by spastic palsy. In this case we would dispel, and let it bleed the spastic parts and still do moxibustion in those conduits that cause the flaccid palsy. A typical example for treatment would be to warm up S34, S36, strength the renal orb by R3 and R7, and at the same time, to dispulse S44, H3 and Pc5 in order to get rid of spasticity (25) (27).

3.3 Rehabilitation Techniques on Post-Stroke Spasticity

Spasticity treatment must be considered in relation to other impairments with functional goals defined prior to intervention (17). Effective management of spasticity requires a multidisciplinary approach both for assessment and treatment and should be viewed addressing with the negative components of the upper motor neuron syndrome and patient's other problems (13) (17).

When the patient presents spasticity that implies on functional and postural loss. The management of spasticity, as well as other pathologies, must be considered within a progressive approach, from the most conservative to the most invasive therapy. The aims of treatment should be improve function (mobility and dexterity); symptom relief; improve posture, and thereby the body image; decrease care burden (care and hygiene, positioning, dressing) and to optimize service responses - to avoid unnecessary treatments, facilitate other therapy, delay/prevent surgery (14).

3.3.1 Physical Treatment

Physiotherapy techniques aim to improve motor performance partly through manipulation of muscle tone. Several approaches are used during rehabilitation, although there is lack of evidence to show which is most effective (20).

The Bobath approach advocates reduction of spasticity and primitive postural reflexes prior to facilitating voluntary activity in paretic muscles with attention to trunk posture and
controlled muscle stretch of the limbs. Reduction in segmental reflex hyperexcitability through inhibition of distal segmental reflexes via Ib inhibitory interneurons is reported using this approach. The Brunnstrom approach advocates techniques to promote activity in weak agonists by facilitating contraction of either corresponding muscles in the unaffected limb or proximal muscles on the paretic side. This technique focuses on individual muscle groups with the underlying concept that stimulation of the weak agonist muscle will result in la mediated reciprocal inhibition in the spastic antagonist muscle. Unfortunately, reduction in la reciprocal inhibition often accompanies spasticity and, therefore, this avenue of reflex suppression may not be available. In some patients where weakness predominates, resistive muscle strength training may improve motor performance without necessarily increase limb spasticity (17).

Guidelines have been made to put each joint through a full range of movement for at least 2 hours in every 24 hours. Maintaining muscle length through passive or active exercise and stretching regimens can be helpful to managing spasticity both in the short and the long time. Correction of postures is also important. The body should be contained in a balanced, symmetrical, and stable posture which is both comfortable and maximizes function (14).

Sensory stimulation using heat and cold can cause short-term reduction in spasticity which can be useful adjunct to physical therapy treatment. An important aspect of preventing and treating abnormal limb posture is maintaining full range of joint movement through regular mobilization and the appropriate use of orthoses to maintain muscle stretch. Orthotic prescription and positioning aids depends on the type of deformity that needs to be controlled and the degree of voluntary limb movement of the patient (17) (14).

3.3.2 Electrical Stimulation

Evidence for direct antispasticity effects of electrical stimulation is limited. Stimulation of an antagonistic muscle group (elbow extensors in this case) with surface electrical stimulation has previously been shown to reduce spasticity temporarily via spinal inhibition during the period of stimulation. However, such effects cease as soon as the stimulation terminated (29) (14).
3.3.3 Pharmacological Management

The choice of drugs to treat PSS depends on severity, anatomic distribution, presence of comorbidities, drug cost, among others. Many stroke survivors have cognitive deficits that may be worsened by the central effects exerted by oral medications, or they are receiving other drugs that are relatively contraindicated for use with certain antispasticity pharmacology (e.g., clonidine and tizandine act in synergy, resulting in hypotension; dantrolene sodium used concurrently with statins may induce hepatotoxicity). Medication should always be used as an adjunct to good general management and education though the effect is short lived. Aims should be to improve function and relieve the adverse symptoms (13). Pharmacological management includes oral medication, intrathecal therapy, intramuscular injection (botulinum toxin) and peripheral nerve blockade.

**Oral medication** (baclofen, benzodiazepines, dantrolene, clonidine, tizanidine, gabapentin) can effectively reduce PSS, but their use is limited by many adverse effects. Because of this, and because of the limited evidence of efficacy attributable to inadequate sample size and lack of quality-of-life measures, it is best to limit the use of these drugs in PSS. However, oral drugs may be cost-effective choices for individuals who achieve adequate spasticity reduction without experiencing adverse events. Oral antispastic medications are helpful for milder cases. However, in more severe cases and for focal spasticity, the side effects, commonly drowsiness and weakness, can significantly restrict the usefulness of these drugs (14).

**Intrathecal Baclofen Therapy** (baclofen pump) is considered if oral drug treatment is inadequate in controlling lower limb spasticity or is not tolerated. The main risks of intrathecal baclofen infusion are symptoms related to overdose or withdrawal. Potential adverse effects are procedure-related or device-related, such as surgical infection, pump malfunction, or catheter interruption. Abrupt disruption of intrathecal baclofen can be a serious scenario with continuous spasms, tremors, temperature elevation, seizure, and death having been reported (14). Common side effects of baclofen pump are similar to the oral form but occur less frequently, largely because much lower intrathecal doses are needed to exert therapeutic effects. Despite the potential benefits of ITB, <1% of stroke patients with severe disabling spasticity are treated with ITB. Possible reasons for this underutilization include surgical risks, excessive weakness, less effect on upper limbs, and limited functional improvement (13).
**Intramuscular Injection** with botulinum toxin is the most commonly used treatment for focal spasticity. The effect of the toxin is to inhibit the release of acetylcholine at the neuromuscular junction. The clinical effect of injecting botulinum toxin is reversible due to nerve sprouting and muscle reinnervation, leading to functional recovery of the muscle in a few months. It is essential that botulinum toxin injections are given in conjunction with physiotherapy in order to obtain the maximum benefit. The toxin is injected directly into the targeted muscle and an effect is noticed in 2-3 days with a maximum effect seen by about 3 weeks, lasting at least 3 months. Drowsiness and sedation, which are commonly associated with oral spasmolytics, are practically nonexistent, and as it is not a permanent treatment, it may have to be repeated after a few months (13).

**Peripheral nerve blockade** (neurolysis) using neurolytic agent (phenol and alcohol) is one of the therapeutic possibilities in the treatment of spasticity. Depending on the dose and concentration used, these agents denature proteins in axons and membranes in afferent and efferent nerve fibers, leading to denervation and degeneration of muscle spindles. Complications of this procedure include post-injection dysesthesia, localized swelling, and excessive weakness. Although nerve blocks are widely used to manage PSS, there is paucity of evidence of efficacy and safety based on randomized controlled studies (13).

### 3.3.4 Surgical Intervention

In patients with severe PSS, complicated by muscle or tendon shortening and who have not had success with the less invasive procedures, surgical interventions are considered. Most studies are limited to case reports or case series. Upper limb surgery, such as tendon transfer of the brachioradialis to extensor digitorum communis, tendon lengthening of the flexor pollicis longus, and release of the flexor–pronator tendons have favorable outcomes in a small case series (13) (14).
3.3.5 TCM Approaches

Commonly applied methods in TCM for stroke rehabilitation, include fostering yin, extinguishing the pathogenic factor ventus, benefiting qi, invigorating xue circulation and freeing the collaterals (6).

Like in western medicine, in traditional Chinese medicine there are different approaches for paralysis of the upper limbs. Pei-xin and Mao-cai present a general point selection, to course the channels and free the collateral, that include pulmunal (lung) 5, felleal (gall bladder) 20, cardial (heart) 1, crassintestinal (large intestinal) 4, 11 and 15 and the extra points baxie. Scalp acupuncture can be also used, with needle the contralateral motor area, sensory area and, for paralysis of the upper limbs, select the middle 2/5 part of the contralateral motor area (6). Porkert and Hempen, defend that in most cases the points, felleal 20, crassintestinal 11, stomach 36 and hepatic (liver) 3 should be stimulated, in combination with other points depending on the Chinese diagnosis (28). Zhao and coworkers present at their study a combination of pericardiac 6, lienal (spleen) 6, regens (governing vessel) 26, cardial 1, pulmunal 5, vesical (bladder) 40 and gall bladder 20 with the junction between vesical 9 and vesical 10, and four equidistant points (30). In the clinical practice, also adjuvant treatments of Chinese medicine should be include, such as auricular acupuncture, tuina, phytotherapy, qigong, and dietetic recommendations (6).


4.1 Organizational Structure

In the framework of master's program in Traditional Chinese Medicine, of the Instituto de Ciências Biomédicas Abel Salazar, this research project was conducted in partnership with the department of physical medicine and rehabilitation of Prelada’s Hospital. The research project did not have any external funding.
4.2 Research Team

Main investigators:

Ana Rita Rebelo Tavares Rodrigues
- Physiotherapist at Clinica 5sensi since 2012;
- Master student of Traditional Chinese Medicine at Instituto de Ciências Biomédicas de Abel Salazar.

Maria João Rodrigues Ferreira Rocha dos Santos
- Master of Traditional Chinese Medicine at Instituto de Ciências Biomédicas de Abel Salazar on 2012;
- Teacher of practical subjects of TCM master at ICBAS;
- Therapist of Traditional Chinese Medicine since 2010.

Research supervisor:

Prof. Doctor Henry Johannes Greten. Head of the Heidelberg School of Traditional Chinese Medicine; President of the German Society of Traditional Chinese Medicine (DGTCM), Heidelberg, Germany.

Co-supervisor:

Doctor Gonçalo Borges. Medical physiatrist, director of physical medicine and rehabilitation service of Prelada’s hospital, Oporto.
4.3 Study Objectives

4.3.1 General Objectives

Evaluate the immediate effect of acupuncture, according to Heidelberg model, on spasticity of the elbow in hemiplegic stroke patients.

4.3.2 Specific Objectives

- Verify if there are any difference on MAS scale;
- Verify the active range of motion;
- Verify the passive range of motion;
- Verify the force that as to be done to extend the elbow 10 degrees.

4.4 Study Design

This work is a descriptive study of a set of clinical cases.

4.5 Participants

The participants of this study come from the department of physical medicine and rehabilitation of Prelada’s Hospital. The inclusion criteria were: (1) history of cerebrovascular accident and having done physiotherapy in the hospital in the last year, (2) stroke-related paralysis of the upper extremity associated with spasticity of the elbow flexors equal or superior of 1 in the MAS, and (3) signing (or be signing by the legal representative) an informed consent based on the institutional ethics review board procedures. Subjects were excluded for the following reasons: (1) if they were medically unstable (e.g. unstable cardiovascular status) and (2) if they suffered significant musculoskeletal problems apart from those related to stroke.
Schematically is shown in figure 6 the process of selection of the sample.

4.6 Instrumentation

4.6.1 Universal Goniometer

The goniometer long has been recognized as an essential tool for clinical practice and research. In 1949, Moore advocated the use of an instrument that is currently considered the universal (standard) goniometer. This goniometer is a protractor with an extended stationary arm and a fulcrum-mounted moveable arm (31). The universal goniometer used was a full-circle plastic goniometer (MSD® EA-8167) with 15 centimeters size – from 0° to 360° moveable arms, marked in 1 degree increments. It was calibrated before each testing session to known angles of 0°, 90°, and 180° degrees as determined from a standard protractor (Table 1) (31).
Angle | Fulcrum | Fixed Arm | Moveable Arm
---|---|---|---
Elbow joint | Humerus' lateral epicondyle | Lateral to humerus in the direction of acromion. | Parallel to the forearm

Table 1 Goniometry references for the elbow (31)

4.6.2 Hook Balance

The hook balance used was a portable electronic scale (Pritech®) with 12x7 centimeters size, and a measurement sensitivity of 5 grams until 10 kilograms. This device was used to assess the strength that is necessary to apply in a passive caudal direction movement, so that the patient’s elbow extends 10 degrees (Figure 8).

![Figure 8](image)

Figure 8 Schematic representation of the procedure to collect the force applied to extend the patient’s elbow passively (10 degrees extension test).
4.6.3 Modified Ashworth Scale

The Modified Ashworth Scale (MAS) measures the level of resistance to passive movement. Although does not evaluate the velocity of passive joint movement, the angle of contraction outbreak or potential tendon retraction, the MAS is effective in clinical practice because of its ease and speed of use. Moreover, this scale is widely used in research and has been highly investigated in many studies and it is established that the MAS evaluates a combination of soft tissue contracture and spastic dystonia, in addition to spasticity itself (2).

4.7 Procedures for Data Collection

Currently we seek to apply to acupuncture the principles and methods used in evidence based medicine, to determine which treatments are really effective, and their validity compared to existing alternatives. For the same pathology there are thousands of different ways to practice acupuncture, and in this sense, it became necessary to produce a document that would standardize in detail the description of the methodology used. Thus, based on CONSORT – Consolidated Standards of Reporting Trials – which standardize the methods of clinical trials, was developed the STRICTA – Standards for Reporting Interventions in Controlled Trials of Acupuncture – which is now the standard of quality for running a clinical trial on acupuncture (attachment 1) (32).

The patients remained seated in a chair with backrest and without arms rest and the feet flat on the floor parallel. At the baseline, before intervention, measurements included: (1) the degree of flexion of the elbow at rest, (2) the range of active motion of the elbow, (3) the range of passive movement of the elbow, (4) evaluating the force required to achieve 10-degree elbow extension, at a slow rate, and (5) measure of spasticity with the Ashworth scale. The evaluation and measurement was always performed by the same researchers in order to decrease the inter-observer variability, and repeated 3 times each measure. Participants were asked who look ahead and to remain relax. After the intervention all parameter returned to be retested (Figure 9).
4.8 Acupuncture Intervention

4.8.1 Acupuncture Points

In the tables 2 and 3 are listed the points used in this study.
<table>
<thead>
<tr>
<th>Points</th>
<th>Crassintestinal 10 (Ic10)</th>
<th>Pulmonar counter point of IC10 (P5')</th>
<th>Pericardiac 6 (Pc6)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chinese Name</td>
<td>Shousanli</td>
<td>-</td>
<td>Neiguan</td>
</tr>
<tr>
<td>HM name</td>
<td>vicus tertius manu</td>
<td>-</td>
<td>clusa interna</td>
</tr>
</tbody>
</table>

### Localization

- **Shousanli L1-10**
  - 2 cun⁵ distal to the depression midway between the lateral epicondyle of the humerus and the transverse crease of the elbow.

- **Pulmonar counter point of IC10 (P5')**
  - In the pulmonary conduit, 2 cun below the centre of the inner side of the elbow, at the inner border of brachioradial muscle (where is P5).

- **Pericardiac 6 (Pc6)**
  - 2 cun proximal to the transverse crease of the wrist, between the tendons of the palmaris longus and the flexor carpi radialis.

---

Table 2 Acupuncture Intervention – Local Points (22) (33)

⁵ Standardized subjective measuring unit (proportional inch = 1 cun) corresponding to the width of the thumb of the patient.
<table>
<thead>
<tr>
<th>Points</th>
<th>Chinese Name</th>
<th>HM name</th>
<th>Localization</th>
</tr>
</thead>
<tbody>
<tr>
<td>Stomach 44 (S44)</td>
<td>Neiting</td>
<td>vestibulum internum</td>
<td>On the dorsum of the foot, in a depression at the aponeurosis on the</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>fibular side of the 2\textsuperscript{nd} toe, distal to the</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>metatarsophalangeal joint</td>
</tr>
<tr>
<td>Lienal 4 (L4)</td>
<td>Gongsun</td>
<td>basis metatarsalis</td>
<td>On the inner side of the big toe, in a depression distal to the basis of the</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>1\textsuperscript{st} metatarsal, on the border of the red and white flesh</td>
</tr>
<tr>
<td>Hepatic 2 (H2)</td>
<td>Xingjian</td>
<td>interstitium ambulatorium</td>
<td>Between the 1\textsuperscript{st} and the 2\textsuperscript{nd} toe, distal</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>to the terminal phalanx of the big toe, about 0.5 cun proximal to the</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>margin of the web.</td>
</tr>
</tbody>
</table>

Table 3 Acupuncture Intervention – Systemic Points (22) (33)
Crassintestinal 10 - beside the coupled effect on the stomach orb, based on the ALT theory, Lc10 has a local action on the elbow, especially in cases of ventus diseases such as pareses and hypertension (26).

Stomach 44 - the effusory of the stomachal orb has a special effects come from the quality that is necessary in extimal stages of disease which are acute, have calor and repletion. Whereas S44 is an extimal point and it is directed against stage II disease. Splendor yang disease is the hottest disease and the most acute disease that we find in the ALT. S44 has a primary effect on the orb; effects that are related to calor primarily on the extima; a general effect on the blocked extima; effects associated with water (like effects on teeth and bones); effects within the framework of ALT (26).

Pulmonary 5', beside the coupled effect on the lienal orb, based on the ALT theory it has a local relaxation action on the elbow, by the harmonizing effect of the pulmonary orb, by breath rhythm. Also balance the wood-metal axis, that in that cases there are an excess of wood, leading to a deficient metal (25).

Lienal 4 opens the impedimental sinartery (chongmai) that carries the xue and is the storage of it, which shall run through the conduit. The impedimental sinartery connects the cardio-renal repport, that is one of the axis imbalanced in the neurologic diseases. It’s a nexory point; a “conecting point” (is the starting point of the reticular conduit which leads to the point of original qi on the opposite side). As a lienal point, it has also a strong influence on the connective tissue, as the function of lienal is “hold the flesh” (25).

Pericardiac 6 open sinarteria retinens yin (retaining net of the yin in the upper caloric). Its also a nexory point, like the L4, very useful in pathologies caused by ventus, that tend to block the reticulars conduits (25).

Hepatic 2 is the effusory (this point’s category, used in acute repleitive and calorous conditions, come up primarily in the hepatic orb) of the hepatic orb and therefore allocated to Fire. In such repleitive condition as spastic and paralyses of the lower and upper limb or unilateral palsy mostly with spastic symptoms, dispulsive needling or bleeding of the point is adequate. Naturally the hepatic orb leads to xue stasis. Within the ALT H2 is good in yin flectens disease, in combination with Pc6 if acute calor is present. This point is used in wood-metal imbalances, that in cases of reactive calor which is normaly treated by S44, as it is involved in the process of regulation and counter-regulation and therefore associated to the centre. This is by the way why reactive calor is strongest in splendor yang states and not in flectens (26).
4.8.2 Acupuncture Technique

The acupuncture technique used in this study consisted in the leopard spot technique, on the points described above, and it was performed using a standard insulin needle. During acupuncture intervention subjects rested in sit position, and as mentioned in Fundamentals of Chinese Acupuncture in 1988, “the procedure should be thoroughly explained to the patient before it is performed to allay his or her fears”. It’s an effective method to obtain immediate results with a special effect on xue flow. In the given clinical scenario it was used to reinforce xue free flow in the affected conduits to treat the pathogenic factor alg or and xue-stasis (6).

Acupuncture with the leopard spot technique, is one of the oldest methods of therapy that is difficult to explain in modern terms, aside from the traditional theoretical basis. It can produce a very effective result and is used for excess type syndromes, where bleeding is recommended because it can drain the excess, alleviate congestion and stasis, and remove the pathogens. As described in Fundamentals of Chinese Acupuncture, the function of blood-letting therapy is “to drain heat or quicken the blood and qi and relieve local congestion” (34) (35). It is claimed on the Yellow Emperor’s Inner Classic to be an effective method to obtain immediate results. This technique belongs to the Layer Analysis Method, or the Five Needling Method, were there are different techniques to treat diseases of the different layers (skin, vessel, muscle, sinew, and bone). The “half needling” was used for the skin layer, “leopard spot needling” was used for the vessel layer, “triple directional needling” was used for the muscle layer, “joint needling” was used for the sinew layer, and “transport needling” was used for the bone layer (23).

The Leopard Spot technique (for the vessel layer) has four major therapeutic aims that are useful in the clinical field (35):

1. It can invigorate the smooth flow of qi and xue, thereby picking up and facilitating its flow when the qi and xue need invigoration. An example of this scenario occurs when a patient presents with a wiry pulse and mild feelings of stagnation that indicate qi stagnation. Improves circulation and prevents xue from remaining stagnated;

2. It disperses qi and xue stasis, as in cases of backache or spider veins;
3. It can drain excess, calor and ardor. Such excess includes pathogenic factors as in an invasion of calor-venti in the pulmonary conduit that produces a fever and extremely sore throat;

4. Bleeding can bring down yang rising, as in the varieties of high blood pressure due to Hepatic yang rising.

The treatment of stroke, coma, mental dysfunctions, and epilepsy by this method may be related to the concept that ventus penetrates to the center and causes severe disruption to the normal brain function; the inside turbulence generates calor on xue; alternatively, a disease with high fever can cause these damaging squeals. This calor may be released by the bleeding of these points, under the concept that xue is a vehicle for carrying out the excess heat (34). The patient can be either in a sitting position or laid down for puncture and the frequency of bleeding is depending on the medical condition. If the patient has an excess of calor and ardor condition such as tonsillitis, bleeding can be performed once a day until the end of the symptom, but if there is a xue stasis condition, bleeding can be done 1-2 times per week (35).

While standard acupuncture therapy is depicted as being effective, in part, by releasing various transmitter substances (i.e., endorphins), by stimulating local blood flow (i.e., by dilating vessels), and by producing changes in the brain that may have both systemic and highly specific effects, letting out a small amount of blood (usually just a few drops) remains without a suitable explanation for the potent effects claimed. The leopard-spot technique is one of quick and light pricking to pierce the skin and vein, however, has fallen into disuse, and there was no further development to reveal his clinical importance. Very few articles focus specifically on use of this technique, instead, standard acupuncture techniques without blood-letting, as well as herbal therapies, are described. Unfortunately, many modern acupuncturists are unfamiliar with this method that could increase the effectiveness of their treatments (23) (34).

4.9 Data Analysis

Data was analyzed by Microsoft Excel 2010. Due to the sample size we refrain to statistical evaluation.
4.10 Ethical Considerations

The research protocol followed the guidelines of the declaration of Helsinki of the World Medical Association. All general ethical principles were respected according to international standards. All participants were informed about the purpose of the study, objectives and procedures, acupuncture technique, side effects and possible adverse effects of acupuncture. At any moment the participants could give up for their participation and they do not cease their conventional medical treatment. A written informed consent was obtained signed by the participant or by their legal representative (Attachment 2 and 3). Data collection respects confidentiality and is only used by the principal investigators of the study. The study was approved by the Ethics Committee of the Prelada’s Hospital.

4.11 Study Finances

The study subjects were invited to participate at no cost. The material of acupuncture was supported by the main investigator, and the physical space for the data collection was assigned by the Prelada’s Hospital.

4.12 Conflicts of Interest

None of the elements of the research team are involved in activities that can represent conflicts of interest.

5. Results

Seven patients (3 male and 4 female), mean age of 60 (±14) years, with spastic hemiparesis were included. Four participants with right side hemiparesis and three left side, with a mean of 63 (±59) months after stroke. On the Table 4 are listed all the database of the participants on this study.
<table>
<thead>
<tr>
<th>Participant</th>
<th>Gender</th>
<th>Age</th>
<th>Affected Side</th>
<th>Time PS (month)</th>
<th>Rest position B</th>
<th>Rest position A</th>
<th>Active Flexion B</th>
<th>Active Flexion A</th>
<th>Active ROM B</th>
<th>Active ROM A</th>
<th>Passive ROM B</th>
<th>Passive ROM A</th>
<th>MAS B</th>
<th>MAS A</th>
<th>Force applied B (N)</th>
<th>Force applied A (N)</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>F</td>
<td>38</td>
<td>R</td>
<td>15</td>
<td>48,67</td>
<td>45,33</td>
<td>95,33</td>
<td>111,67</td>
<td>46,67</td>
<td>66,33</td>
<td>145</td>
<td>145</td>
<td>1+</td>
<td>1</td>
<td>7,03</td>
<td>6,19</td>
</tr>
<tr>
<td>B</td>
<td>F</td>
<td>66</td>
<td>L</td>
<td>18</td>
<td>72</td>
<td>58,33</td>
<td>84</td>
<td>12,67</td>
<td>25,67</td>
<td>145</td>
<td>145</td>
<td>1+</td>
<td>1+</td>
<td>5,39</td>
<td>6,98</td>
<td></td>
</tr>
<tr>
<td>C</td>
<td>M</td>
<td>60</td>
<td>R</td>
<td>39</td>
<td>31</td>
<td>30</td>
<td>124</td>
<td>139,33</td>
<td>93</td>
<td>109,33</td>
<td>145</td>
<td>145</td>
<td>1</td>
<td>1</td>
<td>10,58</td>
<td>17,29</td>
</tr>
<tr>
<td>D</td>
<td>M</td>
<td>44</td>
<td>R</td>
<td>47</td>
<td>50,67</td>
<td>47,67</td>
<td>138,33</td>
<td>138,33</td>
<td>87,67</td>
<td>90,67</td>
<td>145</td>
<td>145</td>
<td>1+</td>
<td>1</td>
<td>8,52</td>
<td>6,75</td>
</tr>
<tr>
<td>E</td>
<td>F</td>
<td>77</td>
<td>L</td>
<td>39</td>
<td>87,33</td>
<td>81,67</td>
<td>125,67</td>
<td>126,67</td>
<td>38,33</td>
<td>45</td>
<td>66</td>
<td>81,67</td>
<td>2</td>
<td>2</td>
<td>8,58</td>
<td>6,44</td>
</tr>
<tr>
<td>F</td>
<td>M</td>
<td>70</td>
<td>L</td>
<td>180</td>
<td>74,33</td>
<td>63,33</td>
<td>123,33</td>
<td>125</td>
<td>49</td>
<td>61,67</td>
<td>145</td>
<td>145</td>
<td>2</td>
<td>1+</td>
<td>6,13</td>
<td>4,38</td>
</tr>
<tr>
<td>G</td>
<td>F</td>
<td>66</td>
<td>R</td>
<td>106</td>
<td>38,33</td>
<td>35</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>95,67</td>
<td>93</td>
<td>3</td>
<td>3</td>
<td>8,86</td>
<td>5,43</td>
</tr>
</tbody>
</table>

Table 4 Data base of the study. M – male; F – female; L – left side hemiparesis; R – right side hemiparesis; PS – post-stroke; B – before intervention; A – after intervention; MAS – Modified Ashworth Scale; N – Newton. Each value presented is the mean of 3 measures.
5.1 Case A

Mrs. T. 38 years old.

Right hemiparesis and aphasia due to ischemic stroke on the field of the left medial cerebral artery on 17 of June of 2013. Currently is doing physiotherapy, occupational and speech and language therapy.

<table>
<thead>
<tr>
<th>Time of Evaluation</th>
<th>Rest Position</th>
<th>Active Flexion</th>
<th>Active ROM</th>
<th>Passive ROM</th>
<th>Ashworth</th>
<th>Force/10°</th>
</tr>
</thead>
<tbody>
<tr>
<td>before</td>
<td>48,67</td>
<td>95,33</td>
<td>46,67</td>
<td>145</td>
<td>1+</td>
<td>7,03</td>
</tr>
<tr>
<td>after</td>
<td>45,33</td>
<td>111,67</td>
<td>66,33</td>
<td>145</td>
<td>1</td>
<td>6,19</td>
</tr>
</tbody>
</table>

After intervention, all the parameter shows some improvement. The rest flexed position diminished, although not significant in goniometric terms. Active flexion, and thereby the active range of movement as well, have been significant improved 20 degrees. There was no limitation on the passive range of movement. On the Ashworth scale was verified a decrease from a slight increase in muscle tone, manifested by a catch, followed by minimal resistance throughout the remainder of the ROM (1+) to a slight increase in muscle tone, manifested by a catch and release or by minimal resistance at the end of the range of motion when the elbow is moved (1). The force applied to extend the elbow 10 degrees also decreases 0,84N.

5.2 Case B

Mrs. L. 66 years old.

Left hemiparesis and aphasia due to ischemic vertebrobasilar stroke on 10 of March of 2013. Currently is doing physiotherapy and speech and language therapy.

<table>
<thead>
<tr>
<th>Time of Evaluation</th>
<th>Rest Position</th>
<th>Active Flexion</th>
<th>Active ROM</th>
<th>Passive ROM</th>
<th>Ashworth</th>
<th>Force/10°</th>
</tr>
</thead>
<tbody>
<tr>
<td>before</td>
<td>72</td>
<td>84,67</td>
<td>12,67</td>
<td>145</td>
<td>1+</td>
<td>5,39</td>
</tr>
<tr>
<td>after</td>
<td>58,33</td>
<td>84</td>
<td>25,67</td>
<td>145</td>
<td>1+</td>
<td>6,98</td>
</tr>
</tbody>
</table>

In this case, there was a significant change in the angle of rest position. Although the active movement after intervention was a little bit smaller, the active range of movement
was bigger due to the start position. The passive ROM does not show any difference, as well as the modified Ashworth scale. There was a slight increase, of 1,59N, at the force applied to move the elbow.

5.3 Case C

Mr. D. 60 years old.

Right hemiparesis due to stroke on 6 of June of 2011. Currently is doing physiotherapy and speech and language therapy.

<table>
<thead>
<tr>
<th>Time of Evaluation</th>
<th>Rest Position</th>
<th>Active Flexion</th>
<th>Active ROM</th>
<th>Passive ROM</th>
<th>Ashworth</th>
<th>Force/10°</th>
</tr>
</thead>
<tbody>
<tr>
<td>before</td>
<td>31</td>
<td>124</td>
<td>93</td>
<td>145</td>
<td>1</td>
<td>10,58</td>
</tr>
<tr>
<td>after</td>
<td>30</td>
<td>139,33</td>
<td>109,33</td>
<td>145</td>
<td>1</td>
<td>17,29</td>
</tr>
</tbody>
</table>

Although the rest position almost remains the same, there was an increase of the active flexion, and thereby of the active ROM, on 16.3 degrees. The passive ROM does not show any difference, as well as the modified Ashworth scale. At the force measure there was an increase of resistance after the intervention of 6,71N.

5.4 Case D

Mr. J. 44 years old.

Right hemiparesis due to hemorrhagic stroke, on the left medial cerebral artery, on 2 of October of 2010. Still do physiotherapy.

<table>
<thead>
<tr>
<th>Time of Evaluation</th>
<th>Rest Position</th>
<th>Active Flexion</th>
<th>Active ROM</th>
<th>Passive ROM</th>
<th>Ashworth</th>
<th>Force/10°</th>
</tr>
</thead>
<tbody>
<tr>
<td>before</td>
<td>50,67</td>
<td>138,33</td>
<td>87,67</td>
<td>145</td>
<td>1+</td>
<td>8,52</td>
</tr>
<tr>
<td>after</td>
<td>47,67</td>
<td>138,33</td>
<td>90,67</td>
<td>145</td>
<td>1</td>
<td>6,75</td>
</tr>
</tbody>
</table>

There was a small diminished in the angle of rest position. Although the active movement remains the same, the active range of movement was a little bigger due to the
start position. There were no limitations on the passive ROM. It was verified a modification on Ashworth score for 1+ to 1, and also a decrease of 1.77N of force applied.

5.5 Case E

Mrs. I. 77 years old.
Left hemiparesis due to stroke on 7 of June of 2011. Still do physiotherapy.

<table>
<thead>
<tr>
<th>Time of Evaluation</th>
<th>Rest Position</th>
<th>Active Flexion</th>
<th>Active ROM</th>
<th>Passive ROM</th>
<th>Ashworth</th>
<th>Force/10⁶</th>
</tr>
</thead>
<tbody>
<tr>
<td>before</td>
<td>87,33</td>
<td>125,67</td>
<td>38,33</td>
<td>66</td>
<td>2</td>
<td>8,58</td>
</tr>
<tr>
<td>after</td>
<td>81,67</td>
<td>126,67</td>
<td>45</td>
<td>81,67</td>
<td>2</td>
<td>6,44</td>
</tr>
</tbody>
</table>

The angle of rest position was a diminished after the intervention. The active movement improves a little, but with the increase of the starting position there was a increase of the active range of motion. The passive ROM also improves about 15.7 degrees, although there was no difference on Ashworth score. The force applied diminished 2,14N.

5.6 Case F

Mr. S. 70 years old.
Left hemiparesis due to stroke on 21 of September of 1999. Currently not under any rehabilitation program.

<table>
<thead>
<tr>
<th>Time of Evaluation</th>
<th>Rest Position</th>
<th>Active Flexion</th>
<th>Active ROM</th>
<th>Passive ROM</th>
<th>Ashworth</th>
<th>Force/10⁶</th>
</tr>
</thead>
<tbody>
<tr>
<td>before</td>
<td>74,33</td>
<td>123,33</td>
<td>49</td>
<td>145</td>
<td>2</td>
<td>6,13</td>
</tr>
<tr>
<td>after</td>
<td>63,33</td>
<td>125</td>
<td>61,67</td>
<td>145</td>
<td>1+</td>
<td>4,38</td>
</tr>
</tbody>
</table>

After intervention, all the parameter shows some improvement. The rest flexed position diminished 11 degrees. Active flexion, and thereby the active range of movement as well, have been significant improved in 12,7 degrees. There was no limitation on the passive range of movement. On the Ashworth scale was verified a decrease from more marked increase in muscle tone through most of the ROM, but affected parts easily
moved (2) to a slight increase in muscle tone, manifested by a catch, followed by minimal resistance throughout the remainder of the ROM (1+). The force applied also diminished 1,75N.

5.7 Case G

Mrs. M. 66 years old.

Right hemiplegia due to hemorrhagic stroke on the left lenticulostriate capsule, on 27 November of 2005. Currently is doing physiotherapy and speech and language therapy.

<table>
<thead>
<tr>
<th>Time of Evaluation</th>
<th>Rest Position</th>
<th>Active Flexion</th>
<th>Active ROM</th>
<th>Passive ROM</th>
<th>Ashworth</th>
<th>Force/10°</th>
</tr>
</thead>
<tbody>
<tr>
<td>before</td>
<td>38,33</td>
<td>0</td>
<td>0</td>
<td>95,67</td>
<td>3</td>
<td>8,86</td>
</tr>
<tr>
<td>after</td>
<td>35</td>
<td>0</td>
<td>0</td>
<td>93</td>
<td>3</td>
<td>5,43</td>
</tr>
</tbody>
</table>

In this case, there was a small diminished in the flexed rest position. The patient does not present any kind of passive movement in the elbow. The passive ROM diminished a little, not significantly, and there was no difference in the Ashworth score also. The force applied was the main improvement in this case, with a diminished of 3,43N applied after the intervention.

5.8 General Considerations

- In all the participants, the elbow flexion at rest position, decreased on average 5,9 degrees (Graphic 1);
- Although the active movement only increase 4.8 degrees, having in consideration the starting position for the movement, the range of movement increase 10,2 degrees (Graphic 1);
- Excluding the one participant, who did not have any kind of active movement at the elbow, all remaining participants increased the range of active movement in average 11,9 degrees;
- Most had no limitation of passive movement, and therefore not seen any change;
Despite being an assessment of an immediate effect it was possible to verify differences in the MAS in 3 participants;

In general there was a diminished of 0.23N of force applied to extend the elbow (Graphic 2);

In 5 of the 7 patients that improve in this parameter, the average decrease of force needed to extend 10 degrees the elbow was of 1.96N.
Spasticity is an abnormal muscle tone recognized clinically as resistance to passive muscle stretch which increases with the velocity of the stretch (17). It is recognized that spasticity after stroke may interfere with motor and activity performance, cause pain, lead to secondary complications and may be a severe problem for some patients after stroke (15). Spasticity is more common in muscles resisting gravity, such as the arm flexors and leg extensors, maybe due to differences in muscle mass in favor of the anti-gravity muscles. The severity of upper extremity spasticity is more associated with the severity of impaired voluntary movements, rather than the lower extremities. These differences between the upper and lower extremities may be explained by differences in supraspinal control, as the upper limb normally functions predominantly under voluntary control, whilst movements of the lower limb have a large influence by the spinal locomotor centres. In the first 3 months after the onset of stroke, the increase in the severity of spasticity in some muscles may be explained by neural changes. After that, the augment in spasticity is more likely to be explained by intrinsic muscle changes. Spasticity makes the patients more prone to develop muscle contracture and muscle contracture may exacerbate spasticity. It’s a vicious circle, and that is why spasticity tends to aggravate over time (36).

Spasticity following a stroke occurs in about 30% of the patients (2). Of the 23 possible patients, 13 had upper limb spasticity, 56.5% of the sample. Unfortunately we cannot reach all of them, having participated about 30% of the initial sample. Post-stroke spasticity shows considerable variability and often does not conform to any of the standard definitions, particularly with regard to the role of muscle tone. Such incongruity between common measures of spasticity and standard definitions of the condition at best complicates diagnosis and at worst results in suboptimal treatment of the patient with spasticity (1). It has been difficult to compare studies of spasticity as the outcome measures in clinical trials or tests have varied due to a lack of precise definition of spasticity (16).

Additional on the impact on the voluntary movements, a flexed elbow posture due to spasticity, may lead to side-effects, such as muscle contractures and pain; persistent elbow flexion, during sitting, standing and walking; difficulties for transfer (no fulcrum), dressing and reaching objects; skin maceration; disfiguring appearance and stretch injury to the ulnar nerve (2). In our clinical cases, after the intervention, this typical characteristic of permanent elbow flexed posture that interferes with all the postural control, decrease in
all the participants a mean value of 5.9 degrees. This may indicates that the tonus was already not so strong to beat the gravity force.

To quantify the full impact of post-stroke spasticity, assessment should include a measure of passive stretch, volitional movement, and active/passive function. The most commonly used clinical measure of spasticity is the Ashworth Scale or its modified version. The MAS measures resistance to passive stretch, i.e., both the tonic stretch reflex and possible intrinsic changes of the muscles; thus, it can be criticized for only reflecting muscle tone of a relaxed limb and for not giving information about activated muscles (13) (15). However, MAS is one of the most commonly used clinical measures of muscle tone. Reliability studies of the scale indicate that a high inter-rater reliability can be achieved, but is not achieved in all conditions. The lack of standard guidelines for positioning and performance may contribute to the variability of results (36). Unfortunately, validation studies showed only ‘moderate’ to ‘good’ intra-rater reliability and ‘poor’ to ‘moderate’ inter-rater reliability. Even if this scale seems to measure the resistance adequately, the reduced range of joint motion due to contractures might also limit its reliability. Furthermore, it is not velocity dependent, as Lance’s definition of spasticity specified (2). The Tardieu Scale has advantages over the Ashworth Scale because it is an interval scale and takes into consideration the velocity dependent nature of spasticity. Tardieu Scale measures the spasticity angle, which is the difference between the angle at the end of passive range of motion at slow stretch and the angle of catch at fast stretch. This estimates the relative contribution of neural mechanisms (i.e., spasticity) and mechanical restraint attributable to rheological changes in soft tissues (13). But, the Tardieu Scale publications regarding its validity and reliability are very limited and only concern children with cerebral palsy, rather than adult patients with stroke. Further studies need to be performed on a larger population to confirm the reliability and the specificity of this scale for assessing spasticity (2). That’s why, in our study, we still opted for the MAS, and to address these shortcomings of its application, we standardize the evaluation process, always being the same position and always the same subject to perform the assessment. Despite being an assessment of an immediate effect it was possible to verify differences in the MAS in 3 participants. The difference in the score was for the immediately level below, in two cases from “slight increase in muscle tone, manifested by a catch, followed by minimal resistance throughout the remainder of the ROM” (1+) to a slight increase in muscle tone, manifested by a catch and release or by minimal resistance at the end of the range of motion when the elbow is moved (1) and in one case from “marked increase in muscle tone through most of the ROM, but affected parts easily moved” (2) to 1+. 
To have an objective measure, to overwhelm the limitation of the MAS we take the physical application of the definition of spasticity, as a “velocity-dependent increase in tonic stretch reflexes”. For that we use an electronic hook-balance to measure the force required to apply on the distal portion of the forearm, to extend passively the patients elbow in 10 degrees. All the measures were done in a slow rate. In 5 of the 7 patients the force applied to extend the elbow decrease a mean of 1.96N. The among of force applied increase in 2 cases, contrary of the expected, but with no repercussions on the active movement, neither on MAS score.

Although the standardized testing procedure using the universal goniometer allowed excessive variability between therapists, measurements taken by the same individual are reliable over time (31). That’s why, in this study, the researcher that performed the evaluations was always the same, in the same conditions. The assess of the active range of movement, was a form to evaluate the functional capacity of the elbow before and after the intervention.

While paresis and loss of dexterity seems the main causes of motor dysfunction in stroke victims, the impact of spasticity remains controversial (17). Some authors defend that post-stroke spasticity may lead to reduced quality of life, increased pain and joint contractures, and that clinically one of the goals of should be to reduce muscle hypertonia (3). The controversy partly reflects the lack of functional benefit found in some studies of antispasticity treatments. But, on the other hand, only a limited number of effective rehabilitation techniques reduce the spasticity per si (3) (17). In our case studies, were seen that after intervention, the active range of movement globally enlarged 10.2 degrees. And if excluded the participant that didn’t have any kind of movement in the elbow (and after intervention maintain the same condition) in all the participants were seen a mean increase in the active range of motion of 11.9 degrees. The active movement of the elbow is a form to deduce the functional capacity of the arm, as selecting the appropriate treatment strategy and goals for the management of post-stroke spasticity should result in favorable functional outcomes. Inappropriate management of the condition can interfere with functional recovery and increase complications. Function is a complex phenomenon that relies not only on muscle tone but also on strength, coordination, endurance, and sensation. Spasticity is a component for a proper function and in many cases can be the negative components of the upper motor neuron syndrome the most problematic (13).

The literature says that prognosis of stroke neurological deficits may be improved mainly the first half year, and the progress may continue through the third year (6). Even do, in our case of studies, a post stroke patient with 15 years of evolution (clinical case F),
with a short time intervention can achieved surprising immediately effects, with an improvement in all the parameters tested.

Post-stroke spasticity management should be guided by its potential impact on function and well-being, considering the duration of condition, previous response to therapies, topographical involvement, response to medication, potential side effects and cost of the intervention. The optimal combination of rehabilitation techniques along with cost-effective medical and neurological management may provide the most favorable outcomes for post-stroke spasticity treatment (13). The usual dug treatments applied have secondary effects. The main adverse effects of oral baclofen include sedation or somnolence, excessive weakness (particularly unaffected muscles), vertigo, and psychological disturbances (14). Dantrolene, while an effective antispasticity agent, causes muscle weakness as well as hepatotoxicity and has not been shown to be useful in stroke. Diazepam adversely affects walking and increases the risk of cognitive dysfunction. These drugs should not be used for the routine management of spasticity in stroke, as, with the development of targeted antispasticity treatments, the role of systemic antispasticity agents in a disease which causes focal spasticity problems is likely to diminish (13). Intrathecal baclofen pump, in stroke patients with unilateral spasticity, bring the risk of weakening muscles on the non-affected and, therefore, is not high-quality choice. Phenol nerve blocks are no longer recommended for treatment of upper limb spasticity, although phenol motor point blocks reduce the risk of sensory disturbance. Alcohol (50%) has been used as an alternative to phenol, but it is less effective (17). Botulinum toxin type A offers the possibility of local treatment of spasticity without affecting sensation. It is an established treatment for blepharospasm, hemifacial spasm and torticollis and has been used for spasticity treatment. The duration of muscle relaxation is usually 3 months, with loss of effect occurring through axonal sprouting proximal to the affected nerve terminal and the formation of new neuromuscular junctions. The impact on function has been more difficult to demonstrate, although improvement of limb posture can translate into reduced disability and carer burden. Current opinion defends the usage of botulinum toxin in conjunction with conventional physical therapy treatments and orthoses. Although being a target specific muscle groups intervention, has a short duration of action, that lead to difficulty in continuing the application on patients with chronic spastic hemiparesis, where it is often required (17).

The current methods of treatments for pain, spasticity and contractures in post-stroke patients are unsatisfactory. Despite a threefold increase in treatment interventions for these conditions over 10 years, still unclear the ‘best practice’ for the rehabilitation of the paretic upper limb (29). Controlled comparative studies have failed to demonstrate the
superiority of any treatment approach in stroke rehabilitation (15). It appears that optimal management of post stroke spasticity requires a combined and coordinated compendium of therapies that encompass cost-effective pharmacological and surgical interventions, along with rehabilitative efforts (13).

Although acupuncture was introduced to Europe long ago, the skepticism about its effectiveness continues to exist, especially where acupuncture has not yet been widely practiced. People question whether acupuncture has a true therapeutic effect, or whether it works through the placebo effect, the power of suggestion, or the enthusiasm with which patients wish for a cure. There is therefore a need for scientific studies that evaluate the effectiveness of acupuncture. Generally speaking, acupuncture treatment is safe, and unlike many drugs, it is non-toxic, and adverse reactions are minimal. This is probably one of the chief reasons why acupuncture is so popular in the treatment of chronic conditions in many countries. Even if the effect of acupuncture therapy is less potent than that of conventional treatments, acupuncture may still be worth considering because of the toxicity or adverse effects of conventional treatments. In the neurological field, strokes and their sequelae are another major indication for acupuncture (37).

Some argue that the importance of spasticity may be overstated, but it is commonly acknowledged that treatment of disabling post stroke spasticity is beneficial. The presence of spasticity is not an only indication for treatment choice, because it may not have a negative impact on the stroke survivor’s well-being. On the contrary, it can be useful in some functional tasks, such as using increased knee extensor tone for standing and transfers, and possibly can preserve muscle bulk and retard osteoporosis. In the upper limb is more reasonable to become disabling or problematic (13). Careful and continual evaluation to establish the causes of a patient’s disabilities is essential before a decision is made on the most proper rehabilitation approach (15). There is no evidence that suppression of spasticity by either physiotherapy or medication results in parallel improvements in motor function (15). Our findings appear to show the other way around, with aspects of motor performance, like the active flexion, being improved.

Despite considerable research efforts on multiple treatment modalities, there is still no single rehabilitation intervention demonstrated unequivocally to aid recovery. This reality drives people to search for other modalities of treatment in an attempt to further improve the outcome of stroke rehabilitation, such as Chinese medicine. Many studies in animals and humans have demonstrated that acupuncture can cause multiple biological responses, including circulatory and biochemical effects. These responses can occur locally or close to the site of application, or at a distance. It leads to activation of pathways
affecting various physiological systems in the brain as well as in the periphery (37). Being a relatively simple, inexpensive and safe treatment compared to other conventional interventions, acupuncture can be a great possibility for the combination of rehabilitation techniques needed to facilitate functional improvements.

7. Study Limitations

As it is a descriptive study through a series of case studies only let us to generate hypotheses. To test the hypotheses, a future prospective, randomized double blinding study is needed. The main lacuna of this study is the sample size that does not let us have a control group, with waiting list or sham acupuncture. In this area of expertise, it would be also interesting to have some enlightened on:

- the effect of acupuncture compared with other conventional therapy, and/or the combination of both;
- how long are kept the effects of a single intervention;
- the long-term effect of this technique, within a rehabilitation program;
- the magnitude of the therapeutic effect in different timings post stroke;
- the influence on functional activities such as reaching and dressing.

8. Conclusion

Despite the lack of scientific evidence on this study, the Heidelberg model of Chinese medicine seems to have some therapeutically benefits on post-stroke spaticity of the elbow flexors. Our study suggests that acupuncture may reduce the spasticity, as well as improve motor performance. A future prospective, randomized double blinding study is needed to assess the long-term effect of acupuncture on spasticity, and to explore the mechanism of action of this treatment technique.

If proven to be effective acupuncture may be a complementary therapy for the treatment of spasticity. A combination of rehabilitation techniques, both Chinese and conventional therapies, should be established in order to have a superior therapeutic benefit for the patient and with the possibility of avoid higher costs and medical side effects.
9. References


10. Attachments
## Attachment 1

### STRICTA 2010

Standards for Reporting Interventions in Controlled Trials of Acupuncture

<table>
<thead>
<tr>
<th>Item</th>
<th>Detail</th>
<th>Page number</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Acupuncture rationale</td>
<td>1a) Style of acupuncture (e.g. Traditional Chinese Medicine, Japanese, Korean, Western medical, Five Element, ear acupuncture, etc)</td>
<td>43</td>
</tr>
<tr>
<td></td>
<td>1b) Reasoning for treatment provided, based on historical context, literature sources, and/or consensus methods, with references where appropriate</td>
<td>27</td>
</tr>
<tr>
<td></td>
<td>1c) Extent to which treatment was varied</td>
<td>33</td>
</tr>
<tr>
<td>2. Details of needling</td>
<td>2a) Number of needle insertions per subject per session (mean and range where relevant)</td>
<td>40</td>
</tr>
<tr>
<td></td>
<td>2b) Names (or location if no standard name) of points used (uni/bilateral)</td>
<td>40</td>
</tr>
<tr>
<td></td>
<td>2c) Depth of insertion, based on a specified unit of measurement, or on a particular tissue level</td>
<td>43</td>
</tr>
<tr>
<td></td>
<td>2d) Response sought (e.g. <em>de qi</em> or muscle twitch response)</td>
<td>43</td>
</tr>
<tr>
<td></td>
<td>2e) Needle stimulation (e.g. manual, electrical)</td>
<td>43</td>
</tr>
<tr>
<td></td>
<td>2f) Needle retention time</td>
<td>NA</td>
</tr>
<tr>
<td></td>
<td>2g) Needle type (diameter, length, and manufacturer or material)</td>
<td>43</td>
</tr>
<tr>
<td>3. Treatment regimen</td>
<td>3a) Number of treatment sessions</td>
<td>35</td>
</tr>
<tr>
<td></td>
<td>3b) Frequency and duration of treatment sessions</td>
<td>35</td>
</tr>
<tr>
<td>4. Other components of treatment</td>
<td>4a) Details of other interventions administered to the acupuncture group (e.g. moxibustion, cupping, herbs, exercises, lifestyle advice)</td>
<td>43</td>
</tr>
<tr>
<td></td>
<td>4b) Setting and context of treatment, including instructions to practitioners, and information and explanations to patients</td>
<td>45</td>
</tr>
<tr>
<td>5. Practitioner background</td>
<td>5) Description of participating acupuncturists (qualification or professional affiliation, years in acupuncture practice, other relevant experience)</td>
<td>34</td>
</tr>
<tr>
<td>6. Control or comparator interventions</td>
<td>6a) Rationale for the control or comparator in the context of the research question, with sources that justify this choice</td>
<td>NA</td>
</tr>
<tr>
<td></td>
<td>6b) Precise description of the control or comparator. If sham acupuncture or any other type of acupuncture-like control is used, provide details as for Items 1 to 3 above.</td>
<td>NA</td>
</tr>
</tbody>
</table>

**Legend:** NA – not applicable
Declaração de consentimento informado


Designação do Estudo (em português):
Efeito Imediato da Acupunctura em Vítimas de Acidente Vascular Cerebral com Hemiparésia Espástica do Membro Superior

Eu, abaixo-assinado (nome completo do participante) _________________________
______________________________________________, compreendi a explicação que me foi fornecida, por escrito e verbalmente, sobre a investigação que se tenciona realizar, para qual é pedida a minha participação.
Tomei conhecimento de que, de acordo com as recomendações da Declaração de Helsínquia, a informação que me foi prestada versou os objectivos, os métodos, os benefícios previstos, os riscos potenciais e o eventual desconforto. Compreendi a informação que me foi dada, tive oportunidade de fazer perguntas e as minhas dúvidas foram esclarecidas.
Foi-me dado todo o tempo de que necessitei para reflectir sobre esta proposta de participação.
Além disso, foi-me afirmado que tenho o direito de decidir livremente aceitar ou recusar a qualquer momento a participação no estudo, sem nenhum tipo de penalização por este facto.
Nestas circunstâncias, aceito participar de livre vontade no estudo acima mencionado e também autorizo a divulgação dos resultados obtidos no meio científico, garantindo o anonimato.

Data ___/___/2014

Assinatura do participante

________________________________________

O investigador responsável
Nome

________________________________________

Assinatura
Declaração de consentimento informado


Designação do Estudo (em português):
Efeito Imediato da Acupuntura em Vítimas de Acidente Vascular Cerebral com Hemiparésia Espástica do Membro Superior

Eu, abaixo-assinado (nome completo do representante legal do indivíduo participante do estudo) ____________________________, na qualidade de representante legal de (nome completo do participante) ____________________________, compreendi a explicação que me foi fornecida, por escrito e verbalmente, sobre a investigação que se tenciona realizar, para qual é pedida a sua participação. Tomei conhecimento de que, de acordo com as recomendações da Declaração de Helsínquia, a informação que me foi prestada versou os objectivos, os métodos, os benefícios previstos, os riscos potenciais e o eventual desconforto. Compreendi a informação que me foi dada, tive oportunidade de fazer perguntas e as minhas dúvidas foram esclarecidas. Foi-me dado todo o tempo de que necessitei para reflectir sobre esta proposta de participação. Além disso, foi-me afirmado que tenho o direito de decidir livremente aceitar ou recusar a qualquer momento a participação no estudo, sem nenhum tipo de penalização por este facto. Nestas circunstâncias, autorizo de livre vontade a participação daquele que legalmente represento no estudo acima mencionado e também autorizo a divulgação dos resultados obtidos no meio científico, garantindo o anonimato.

Data ___/___/2014

Assinatura do representante

__________________________

O investigador responsável
Nome

__________________________

Assinatura