A Possible Pharmacotherapy-Avoiding Break-Through in Physical Therapy Treatment during Early Rehabilitation of Patients with High Muscle Tone after Thalamus Hemorrhage

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Abstract: - Deep dry needling (DDN) treatments were given during early rehabilitation to a 48-year-old male subject who suffered from brain hemorrhage with the objective to diminish hypertension. DDN treatment at such an early stage of recovery has not been well documented until now. It is new in, among some other aspects, that it avoids the commonly applied pharmacotherapy that is intended to decrease the hypertension, but that often appears hardly effective or not effective at all, or sometimes possibly even counter-effective. A pre-intervention test was performed to record baseline values, and the same aspects were measured again, directly after, and approximately one hour after the intervention. The results for the range of movement (ROM) of the subject's right-side extremities were assessed through the Tardieu scale. It could be deduced that DDN did not result in a long-lasting reduction of the tension, but that the ROM values for the elbow joints within the treated muscles improved significantly during and immediately after the treatment, allowing better alignment and more active movement. It thus appeared that the DDN-induced temporarily improved ROM facilitated treatment and allowed the subject to exercise in a better alignment and more effectively during treatment. The experience with the subject makes it likely that DDN during early rehabilitation makes a post-stroke subject more comfortable (because of reduced spasticity/hypertension) and helps making physical therapy treatment of post-stroke patients more effective although no spasticity-reducing pharmacotherapy need be given, thus also increasing the cost-effectiveness of the treatment.

Key-Words: - brain hemorrhage, DDN, dry needling, early rehabilitation, hypertension, physical therapy, spasticity.

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1 Introduction

Treatments in the form of medicines were given already in prehistoric times, based on empirical results. The positive results in the course of time in ever more and ever more effective medicines. It is now increasingly recognized in the medical community, however, that the 'classical' prescription of medicines to treat specific physical malfunctioning is not always the best cure: although medicines still play a major role in the treatments of patients, pharmacotherapy occasionally has not the expected result, or maybe even counter-effective. Consequently, ever more practice-oriented research is aimed at finding out how the biological functioning can be repaired, while avoiding possible negative side-effects of pharmacotherapy.

An example is the case where post-stroke patients are treated by physical therapists. Such treatments may include several techniques [1], including 'classical' ones such as medicines [2] and

advanced techniques such as brain-computer interfaces, robot-assisted and virtual reality, brain stimulation, and cell therapies, [3]. Such treatments may be given at different times, [4]. Not all treatments are equally successful [5], and physical therapy therefore still plays a major role.

One of the major problems for the physical therapy treatment of such patients is that they suffer commonly from hypertension, often due to a perceptivity problem. It should be noticed here that hypertension because of a perceptivity problem is fairly frequently confused with spasticity, because the symptoms are commonly much alike. The hypertension causes that the patient tends to raise his muscle tone to get the joints in an exceptional position that will help him/her to feel his/her position better. This can concern flexion or extension, and the positions thus taken are often the same as those during spasticity.

Such an unnatural, forced position of arms and/or legs may, obviously, hamper optimization of physical therapy treatment during early rehabilitation, because the treatment is uncomfortable for the patient and requires more effort and time from the physical therapists. Consequently, the physical therapy treatment of such patients takes, as a rule, relatively much time. It would therefore be helpful if a method could be developed that makes the physical therapy treatments of such patients during early rehabilitation more efficient and effective. Earlier experiences with the effect of deep dry needling (DDN) indicated that this technique might be helpful, [6], [7]. It was therefore decided to apply this technique to a patient where physical therapy posed a problem for the above reasons.

In the case dealt with here, it was agreed among all professionals involved, after several treatments and repeated assessment of the results, that the patient, who had brain hemorrhage, suffered from hypertension and not from spasticity. The main argument was that the patient showed during treatments that he was able to move both his right-side arm and leg out of the typical spasticity pattern, which is atypical for spasticity.

The reason for the massive flexion of his arm and leg was a perception problem; this made him feel his arm or leg only in extreme flexion. This problem can commonly be reduced by pharmacological therapy, but such a therapy can easily interfere with the physical and occupational therapies. Deep dry needling, which is an emerging non-pharmacological technique which can be applied to reduce spasticity and hypertension without the side effects of pharmacotherapy, was therefore applied with the sole intention to reduce the patient's hypertension so that an immediately following standard physical therapy would be more comfortable for the patient, and would make the work easier for the physical and occupational therapists. Such a treatment has not been documented thus far for therapy during early rehabilitation of patients with cerebral hemorrhage.

2 Material and Methods

The present study concerns a 48-year-old male patient who suffered from a thalamus hemorrhage, which, because of a midline shift and the resulting increased brain pressure, had to be relieved by craniotomy. In addition to his left-side hemorrhage, the patient suffered from subluxation to anterior of his right humerus, extreme hypertension of the right-side extremities in flexion, and a severe perception deficit, in combination with loss of his capability to speak. This resulted in decreased muscle length in flexion muscles, and consequently a decrease in ROM in extension (particularly of the biceps brachii, the flexion muscles of the forearm and the fingers, the adductor muscles of the right hip, the ischiocrural muscles, the gastrocnemius and the soleus).

2.1 Therapies and Clinical Course

Before early rehabilitation started, the patient had extreme flexion positions in both his right arm and leg, particularly when lying in bed or sitting in a wheelchair. He was treated according to standard care during early rehabilitation at the ANR (early rehabilitation) Department of Zurzach Care (Baden, Switzerland). This included minimally two hours per day of direct therapeutic treatment as well as two hours of therapeutic care, divided over 15-45 minute periods. The direct therapeutic treatment consisted of at least two interventions a day, commonly in the form of team treatment by two physical therapists or a physical and an occupational therapist; additional therapy was provided by a speech/dysphagia therapist.

After the transfer from the acute hospital to the early rehabilitation unit, still with the partly removed skull, moderate but increasingly severe hypertension became apparent, predominantly in his right forearm and fingers and his semitendinosus, semimembranosus, biceps and gastrocnemius.

Treatment with antispastic agents had only limited effect and was consequently stopped after two weeks.

Early rehabilitation included deep dry needling (DDN); it started in the third week after transfer to the early rehabilitation department, exclusively with the intention to reduce what was initially considered as spasticity (only later it was agreed by the treating professionals that the term "hypertension" was more appropriate) and to increase the passive range of motion (ROM) without the sedative side effects of antispastic medication. Tolerability of DDN was assessed by motoric and verbal reactions. Once established, the frequency of DDN treatment was three times a week (about 25 minutes per session), for a duration of seven weeks.

The spasticity therapies included mobilization, both at bedside and in a passive wheelchair, on a treatment table and subsequently also in a functional standing frame [8], as well as additional muscle-tone reducing measures by both the physical and the occupational therapists.

For objectively measuring the results of the DDN treatment regarding the extension of the elbow, we used the Tardieu scale [9], [10] and ROM values to determine the spasticity and passive ROM, [11].The ROM of the elbow and wrist was measured using a goniometer.

For the purpose, a pretest-posttest (pre-treatment) evaluation was designed with assessment at 2-4 points for one arm after baseline measurements had been performed (Table 1). Since it appeared soon that a decrease in muscle tone occurred for all treated muscles directly after treatment, but that there was no clear improvement at the longer term, the original assessment protocol was changed to before treatment (T0) directly after treatment (T1), and 1 hour after treatment (T2). All measurements were performed under the same conditions.

2.2 Intervention

Dry needling was performed for 45-60 s at all points with severe high tone/spasticity, particularly of the taught bands. The duration of the total treatment period was seven weeks. During this time, re-implementation of the removed part of his skull occurred at the university hospital of Zürich.

Before the actual DDN treatment started, one place in the right biceps brachii and one place in the right gastrocnemius were treated with DDN to test for both tolerability and local response to this type of treatment. These muscles were chosen because they are easily accessible and had the highest tone. The fast reduction of the muscle tension and the absence of negative effects made the therapist decide, in consultation with the neurologist, to follow-up this test by a more extensive treatment.

This actual treatment started within the first week with three days (separated from each other by one day of rest) of DNN treatment of the biceps brachii, the brachioradialis and the forearm flexors, in addition to the daily therapy treatments according to standard care. The treatment regime was re-assessed and adapted after two weeks when it had become clear that the patient suffered from hypertension rather than from spasticity.

The results directly after treatment showed a decrease in muscle tone for all treated muscles. After consultation with the Head of the Department, the assessment protocol was therefore changed to before, directly after and one hour after treatment.

During the final two weeks, the DNN treatment was similar again as in the first week: treatments during three days per week (separated by one day of rest). The treatment involved the biceps brachii, the flexor muscles of the lower right arm, and the ischiocrural muscles and calf muscles of the right leg..

Table 1. Baseline measurements regarding the right-side elbow ROM of the patient before start of the treatment period

ROM	flexion quality (Q)*	
elbow ROM (extension/flexion)	V1** (extension)	V3** (extension)
25°-25°/145°	70° / Q = 2	catch at 110° / Q = 2

** Flexion quality was determined following the Tardieu scale. Q = 2: clear catch at a precise angle followed by release.*
*** V1 = moving as slowly as possible, in this case from extension to flexion; V3 = at a fast rate, faster than gravitational pull. Note: V2 (speed of the limb segment falling with gravitational pull) could not be measured because the arm could not fall down against the hypertonia.*

3 Results

After the first week (three treatments of the triceps and of two forearm flexors and the brachioradialis, each with two needles), the right arm had become more relaxed. There was less tension directly after the treatment; moreover, the ROM in the elbow, the hand and the fingers had improved as compared to the baseline values (Table 1). The elbows could be

extended farther. It seemed that all joints in the right arm were somewhat more rigid than before, but accurate measurement with a goniometer was impossible because of sudden increases in muscle tone. A movement of 10-15° directly after treatment seemed possible, but one hour later, the ROM was again comparable to before the treatment.

After including a re-assessment one hour after treatment, the planning of the treatments was also changed back to the standard care: physical and occupational therapy were given directly after the DDN treatment two out of the three times a week that DDN was applied. Physical and occupational therapists then noticed that treatment directly after DDN could start more easily with a more extended position of both the arm as the leg and that it was possible to do more weight-bearing because of a better posture und better extended joints: therapy immediately after DDN made it possible for the patient to stand in a better upright position and to keep this position for a longer time. This implies that the objectives of the practice-oriented study had been reached completely: more comfortable treatment for the patient, easier and more effective treatment by the physical and occupational therapists, and quicker results than could be obtained with standard care.

4 Discussion

This is the first case describing the results of DDN for a post-stroke patient with extensive muscle tone during early rehabilitation with assessments before, immediately after and one hour after the DDN treatment. It should be mentioned in this context that DDN is a relatively new technique that has shown to be effective not only for reducing the general pain of post-stroke patients [12], but also for reduction of pressure-induced pain, [13]. It has been found that DDN appears particularly effective in the case of neurological conditions. This was already well known for babies with cerebral palsy, [14], [15] and the relationship between DDN and the brain was also indicated by DDN treatment for spinal cord injury, [16], [17]. This explains why DDN may also be effective in the treatment of post-stroke patients with a high muscle tone. The medical community in some Kantons of Switzerland has therefore decided that DDN is allowed in rehabilitation if a patient suffers from high muscle tone. Such DDN treatments were for many years typically started only in the course of the rehabilitation process, particularly for treatment of pain [18], [19], [20] and normal hypertensia [21], [22]. DDN treatment in neurology [23] has, however, been successfully applied in later phases of rehabilitation of post-stroke patients [13], but has thus far not been applied in an early rehabilitation setting.

Because better treatment with standard physical therapy appears possible after a DDN treatment – either or not in combination with other types of treatment (e.g., [24] – and because of the resulting improved ROM and alignment of joints, it seems worthwhile to start more extensive studies in order to determine whether our findings are generically valid, or whether they represent a more or less exceptional case. The reason why we did not carry out such a study ourselves is that no such patients were present in our hospital at the time. Yet, such an extended study would be important because it might deepen the insight into the effect of DDN on spasticity and hypertension. To assess the effects, systematic baseline measurements should be followed by measurements directly after treatment and a specific time afterwards.

Another reason for such a study is that it cannot be decided on the basis of our observations whether our approach was optimal. Nor can it be deduced whether there are long-term effects. It is obvious, however, that our patient tolerated the DDN treatment well with distinct reduction of the hypertension, in spite of significant reduction of antispastic pharmacotherapy. Further studies might well contribute to the development of a practice-based, optimized DNN treatment to be used for severely injured patients with brain damage.

5 Conclusions

A patient with severe hemorrhage and craniotomy has been treated with DDN in an early stage of rehabilitation, with the sole objective to reduce muscle tone just before standard treatment by physical and occupational therapists.

This would make the standard physical therapy more comfortable for the patient and easier for the physical and occupational therapists, in spite of the lack of the commonly given pharmacotherapy. The DDN treatment was well tolerated and without complications. A significant increase of the ROM of the various joints occurred directly after treatment. The tone of the treated muscles decreased following the Tardieu scale (Table 2, Appendix).

The implications of the new approach for rehabilitation of post-stroke patients suffering from spasticity or hypertension can be summarized as follows:

* the spasticity/hypertension causes that they feel their arm or leg only in extreme flexion;
* this hampers effective and efficient physical therapy significantly;
* deep dry needling shortly before the standard physical therapy reduces the spasticity or hypertension;
* this makes the physiotherapy more comfortable for the patient and requires less time and effort from the physical or occupational therapist;
* a side effect is that the more efficient treatment may reduces the total period of treatment and thus the cost.

Since no comparable studies have ever been documented, even better results might be obtained by adaptations of our approach, but our results show that DDN is well tolerated and probably helpful for the rehabilitation of severely injured patients with brain hemorrhage who suffer from severe tone, particularly if treatments of the standard care are given directly after the DDN treatment. Although the absence of other studies with a comparable early-rehabilitation DDN treatment prevent drawing definite generic conclusions our approach seems to represent a break-through for the physical therapy treatment during early rehabilitation of patients with severe brain damage. The new approach may well help to reduce the negative side-effects that are not uncommon if pharmacotherapy is given to such patients, and avoids the exceptionally high costs that are involved in advanced techniques such as brain stimulation sand cell therapy.

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The authors have no conflicts of interest to declare that are relevant to the content of this article.

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All relevant data underlying the present contribution are provided in the two tables.

APPENDIX

Table 2. Changes in ROM of the patient's right elbow joint and quality according to the Tardieu scale before (T0), directly after (T1) and 1 hour after treatment (T2) during the successive days of treatment

T0			**T1**			**T2**		
ROM	flexion quality (Q)*		ROM	flexion quality		ROM	flexion quality	
	V1**	V3		V1	V3		V1	V3
110°	2	2	85°	1	2	105°	2	2
110°	2	2	90°	1	2	110°	1	2
110°	1	2	85°	1	2	105°	1	2
110°	1	2	80°	1	2	105°	1	2
105°	1	2	85°	1	2	95°	1	2

** Flexion quality was determined following the Tardieu scale. Q = 1: slight resistance throughout, without a clear catch at a precise angle; Q = 2: clear catch at a precise angle followed by release.*

*** V1 = flexing as slowly as possible; V3 = at a fast rate, faster than gravitational pull. Note: V2 (speed of the limb segment falling with gravitational pull) could not be measured because the arm could not fall down against the hypertonia.*