·Special Papar·

New Concepts and Evidence Based Practice in Physiotherapy: Examples from Stroke Rehabilitation

Langhammer Birgitta, RPT, PhD[1]

Objective: The purpose of this paper is to give an overview of new concepts and evidence based physiotherapy practice in stroke rehabilitation in the acute, post acute and chronic stage of stroke.

Background: Historically physiotherapy has developed through the years from a focus on health, beauty, and equilibrium between spiritual, moral and physical powers, to a client centered service to people and populations to develop, to maintain and to restore maximum movement and functional ability throughout the lifespan. Still the health perspective is strong and divided into first, second and third prophylaxis. New concepts like Evidence Based Medicine, Evidence Based Practice, International Classification of Function and research within neurophysiology have had a deep impact on physiotherapy services, practice and education. The highest levels of documentation are Meta analyses and Randomised Controlled Trials, and today many of the physiotherapy methods used in rehabilitation of neurological conditions are tried out in different trials, bringing up-to date knowledge into practice. This paper focuses on rehabilitation of persons with stroke and physiotherapy methods in particular.

Result: Physiotherapy in the acute stage improves motor function and enhances mobility. Rehabilitative efforts within the first few weeks as opposed to later favors better recovery. Type of physiotherapy in the acute stage is task oriented training with a focus on intensity and variability. Post acute therapy-based rehabilitation services targeted towards stroke patients living at home appear to improve independence in personal activities of daily living. In the chronic stage there is good evidence that aerobic exercise is beneficial for improving aerobic capacity in people with mild and moderate stroke. Progressive resistance strength training programmes reduce musculoskeletal impairment after stroke, without increasing tone or spasticity.

Key word evidence based practice; physiotherapy; stroke

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This paper is based on a talk held at the 5th Beijing International Forum on Rehabilitation 2010. The purpose was to highlight new concepts and evidence based practice in general and in regard to stroke rehabilitation in particular.

1 Physiotherapy in a Historical Perspective

Historically physical therapy, as we know it, was practiced already in ancient China 2500 BC, where physical treatment and massage were important ways in attaining the goal to become a harmonic human being. Characteristics of a harmonic human being were health, beauty, and equilibrium between spiritual, moral and physical powers. Different movements were practiced like gymnastics, sports and dance in order to attain health and the balanced harmonic ideals. Different forms of hydrotherapy were practiced in ancient Egypt, Greece, Roman empire, China and Japan as a medical treatment, physical therapy and for hygienic purposes[1].

During the middle ages in Europe, the mind and spirit was at focus and the body and health aspects were of less importance so the techniques and philosophies were forgotten to be re-established first in 18th century[1].

1813 PH Ling established physiotherapy, as a "mechanical medicine" in the Swedish school of sports and health sciences. This was spread to Germany where in 1853

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1 Oslo University College and Sunnaas Rehabilitation Hospital
Birgitta.Langhammer@hf.hio.no

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"schwedische Heilgymnastik" was introduced. In 1887, Physiotherapists were given official registration by Sweden's National Board of Health and Welfare. Soon after, in 1894, the UK recognized physiotherapy as a specialized branch of nursing regulated by a Chartered Society (massage) and in 1897 an orthopedic medico mechanical institute, a physiotherapy institute, was established in Norway. It was followed shortly after by the establishment of formal physiotherapy programs in New Zealand 1913 and in the USA 1914[1].

The polio epidemic of the 1920's was a landmark turning point for the physiotherapy profession and the profession developed new treatment modalities and techniques. Physiotherapists also moved beyond hospital-based practice to outpatient orthopedic clinics, public schools, colleges/universities, geriatric settings (skilled nursing facilities), rehabilitation centers and medical centers at this time. The first professional associations were founded in 1921, and in 1951 the World Confederation in Physical Therapy (WCPT) was established with 11 member organizations. Today WCPT has grown into 101 member organizations, organized into five different regions: Africa, Asia Western Pacific, European, North America Caribbean, and South America[2]. A definition of physiotherapy has been proposed and accepted by the WCPT and it defines physiotherapy as:

"The nature of physical therapy is providing services to people and populations to develop, to maintain and to restore maximum movement and functional ability throughout the lifespan. Physical therapy includes the provision of services in circumstances where movement and function are threatened by the process of aging or that of injury or disease. Full and functional movements are at the heart of what it means to be healthy"(WCPT, 14th general meeting 1999).

2 Evidence Based Medicine

Evidence-based medicine (EBM) attempts to objectively evaluate the quality of clinical research by critically assessing techniques reported by researchers in their publications. The explicit methodologies used to determine "best evidence" was largely established by the McMaster University research group led by David Sackett and Gordon Guyatt [3—5]. The term "evidence-based medicine" first appeared in the medical literature in 1992 in a paper by Guyatt et al[3].

The practice of evidence based medicine means integrating individual clinical expertise with the best available external clinical evidence from systematic research. By individual clinical expertise it is meant the proficiency and judgment that individual clinicians acquire through clinical experience and clinical practice.

Best available external clinical evidence is defined as clinically relevant research, from the basic sciences of medicine, but especially from patient centered clinical research into the accuracy and precision of diagnostic tests (including the clinical examination), the power of prognostic markers, and the efficacy and safety of therapeutic, rehabilitative, and preventive regimens. External clinical evidence both invalidates previously accepted diagnostic tests and treatments and replaces them with new ones. Evidence based medicine is not restricted to randomized trials and meta-analyses. It involves tracking down the best external evidence with which to answer our clinical questions. Sometimes the evidence needed is produced from the basic sciences such as genetics or immunology. To find out about the accuracy of a test, however, proper cross sectional studies are needed. For a question about prognosis; proper follow up studies of patients assembled at a uniform, early point in the clinical course of their disease are essential[4-5].

It is when asking questions about therapy that the non-experimental approaches should be avoided since these routinely lead to false positive conclusions about efficacy. Because the randomized trial, and especially the systematic review of several randomized trials, is so much more informative and so much less likely to mislead, it has become the "gold standard" for judging whether a treatment does more good than harm[5].

EBM aims to apply evidence gained from the scientific method to certain parts of medical practice, and EBM seeks to assess the quality of evidence relevant to the risks and benefits of treatments, including lack of treatment. The strongest evidence for therapeutic interventions is provided by systematic review of randomized, double-blind, placebo controlled trials, involving a homogeneous patient population and medical condition(Fig 1).

In order to rank the quality of evidence, EBM categorizes different types of clinical evidence and rates or grades them according to the strength of their freedom from the various biases that may be present in the medical research[6].

An example is the US Preventive Services Task Force which ranks the evidence into numbered levels and sub-

Figure 1 Evidence-Based Medicine Pyramid[4]

levels, a total of 5 levels:

Level I: Evidence obtained from at least one properly designed randomized controlled trial.

Level II-1: Evidence obtained from well-designed controlled trials without randomization.

Level II-2: Evidence obtained from well-designed cohort or case-control analytic studies, preferably from more than one center or research group.

Level II-3: Evidence obtained from multiple time series with or without the intervention. Dramatic results in uncontrolled trials might also be regarded as this type of evidence.

Level III: Opinions of respected authorities, based on clinical experience, descriptive studies, or reports of expert committees.

The UK National Health Service ranks evidence into alphabetic levels, a total of 4 levels:

Level A: Consistent Randomized Controlled Clinical Trial, cohort study, all or none (see note below), clinical decision rule validated in different populations.

Level B: Consistent Retrospective Cohort, Exploratory Cohort, Ecological Study, Outcomes Research, case-control study; or extrapolations from level A studies.

Level C: Case-series study or extrapolations from level B studies.

Level D: Expert opinion without explicit critical appraisal, or based on physiology, bench research or first principles.

The quality of methodology, the internal validity and interpretable results are also important aspects of the evaluation of Randomized Controlled Trials and systematic reviews. Tools to evaluate the quality are for example the PEDro scale based on the Delphi list developed by Verhagen and colleagues [7-8]. The randomized controlled trials are assessed on the eleven items of the PEDro scale and level of validity and interpretability can easily be identified.

3 Evidence Based Practice

The term evidence-based practice (EBP) or empirically-supported treatment (EST) refers to preferential use of mental and behavioral health interventions for which systematic empirical research has provided evidence of statistically significant effectiveness as treatments for specific problems. It is an approach which tries to specify the way in which professionals or other decision-makers should make decisions by identifying such evidence that there may be for a practice, rating it according to how scientifically sound it may be. The goal is to eliminate unsound or excessively risky practices in favor of those that have better outcomes.

EBP promotes the collection, interpretation, and integration of valid, important and applicable patient-reported, clinician-observed, and research-derived evidence. The best available evidence, moderated by patient circumstances and preferences, is applied to improve the quality of clinical judgments and facilitate cost-effective care. EBP develops individualized guidelines of best practices to inform the improvement of whatever professional task is at hand. Evidence-based practice is a philosophical approach that is in opposition to rules of thumb, folklore, and tradition.

It is important to remember that evidence-based-practice is not just blindly following published evidence - it has to be combined with two other important elements - clinical expertise and patient wishes and expectations(Fig 2).

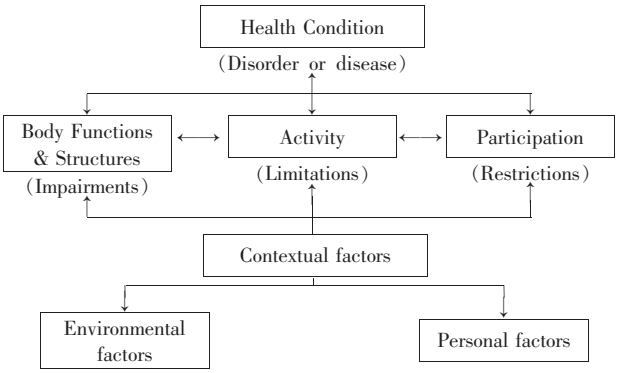
4 International Classification of Function

Figure 2 The Triad of Evidence Based Practice[9]

The International Classification of Functioning, Disability and Health, known more commonly as ICF, is a classification of health and health-related domains. These domains are classified from body, individual and societal perspectives by means of two lists: a list of body functions and structure, and a list of domains of activity and participation. Since an individual's functioning and disability occurs in a context, the ICF also includes a list of environmental factors[10].

The ICF is WHO's framework for measuring health and disability at both individual and population levels. It provides a unified and standard language and a framework for the description of health and health-related states. Besides standardize concepts and terminology across the globe it is also useful to standardize and categorize treatment and tests, to identify patients 'problems and the "levels" of problems. It can help organize physiotherapy practice by identifying if it is a problem on body function /strucutural activity or environmental level and how this might influence the person. Lastly, ICF can be of help in identifying strengths and weaknesses in therapy through evaluation in regard to the concept(Fig 3).

Figure 3 A model of the International Classification of Function[10]



5 Evidence Based Practice: an example from stroke rehabilitation stroke-sensorimotor function

A stroke, known medically as a cerebrovascular accident (CVA), is the rapidly developing loss of brain function (s) due to disturbance in the blood supply to the brain. This can be due to ischemia (lack of blood flow) caused by blockage (thrombosis, arterial embolism), or a hemorrhage (leakage of blood)[11].

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 understanding speech; difficulty seeing with one or both eyes; difficulty walking, dizziness, loss of balance or coordination; severe headache with no known cause; fainting or unconsciousness.

The effects of a stroke depend on which part of the brain is injured and how severely it is affected. A very severe stroke can cause sudden death.

The symptoms described relate to bodily functions and body structures that are affected, for example numbness and /or weakness which are related to sensory-motor functions. Numbness or sensory loss means that sensory input or stimulation is not registered; the signal provided by a system's sensors, afferent; conveying nerve impulses from the sense organs to the nerve centers does not come through. The term sensory input refers to the (objective) information available to the system, given the properties of the sensors. However, sensory input is distinguished from what is called sensation, which has a phenomenal aspect, and from perception which has both a phenomenal and a categorical aspect[12-13].

The sensory input triggers the motor output, which is the signal, sent efferent conveying nervous impulses to "effectors". The notions of "sensor" and "effectors" are not trivial, and may depend on the point of view from which one analyses the interaction of the system with its environment. Furthermore, the notion of "signal" is also not trivial: does this mean the actual neural or electrical impulses, coded in the particular way they are coded? Or does this mean some intrinsic aspect of the input and output, independently of how it is coded.

A sensorimotor interaction in which a system built for a purpose controls the interaction in a skillful way. That is, it can modify the input-output in a way that is in some sense adapted to one of its purposes[14-15].

However, sensory information does not have unfettered access to its targets in the central nervous system (CNS). "Sensorimotor gating" refers to the state-dependent regulation of transmission of sensory information to a motor system. Sensorimotor gating often occurs via pre-synaptic inhibition of the activated sensory neuron [14]. A behavioral role for the pre-synaptic inhibition of proprioceptive input in mammals has been described and new cellular mechanisms underlying sensorimotor gating have been revealed. Cellular-level mechanism for a type of sensorimotor gating called

"pre-pulse inhibition" has been proposed[12,16].

So, external sensory input is important for our understanding of the outside world but the information is "censored" depending upon what is perceived as important in that instant in our CNS in relation to the action/task(cognition, learning, memory) and depending upon environmental circumstances and personal preferences.

6 Neuroplasticity

Neuroplasticity or cortical re-mapping refers to the ability of the human brain to change as a result of one's experience. It refers to the brains capacity to re-wire and re-organize, and this capacity is shown to be lifelong[17—18].

"Neurons that fire together, wire together"/"neurons that fire apart, wire apart."

If there are two nearby neurons that often produce an impulse simultaneously, their cortical maps may become one. A consequence of neuroplasticity is that the brain activity associated with a given function can move to a different location; this can result from normal experience and also occurs in the process of recovery from brain injury. Neuroplasticity is the fundamental issue that supports the scientific basis for treatment of acquired brain injury with goal-directed experiential therapeutic programs in the context of rehabilitation approaches to the functional consequences of the injury.

Plasticity in more recent writing is frequently described as a property of the central nervous system with the term reorganization used to introduce the specific types of changes observed including axonal sprouting, long-term potentiation or the expression of plasticity related genomic responses.

There is now ample evidence for the active, experience-dependent re-organization of the synaptic networks of the brain involving multiple inter-related structures including the cerebral cortex[19].

7 Motor Control-Motor Learning

Motor control theory is part of the theoretical basis of clinical practice. Motor control is defined as the systematic transmission of nerve impulses from the motor cortex to motor units; resulting in coordinated contractions of muscles [20]. However, theory of motor control can also be viewed as an idea of the nature and cause of movement [21]. It deals with stabilization of the body in space, as this applies in postural and balance control, and with moving the body in space, as this applies to movement[21—23].

A theory of motor control was presented by Shumway-Cook and Wollacott as a systems approach [21]. This theory defines movement as an interaction between the individual, the task and the environment, where movement is the result of a dynamic interplay between perceptual, cognitive and action systems. Action systems are defined as the neuromuscular aspects and the physical/dynamic properties of the musculo-skeletal system itself. Motor control is usually studied in relation to specific actions or activities[21].

Motor learning is the process of improving motor skills through practice, with long-lasting changes in the capability for responding. The cerebellum and basal nuclei play a major role in such coordination [20]. Through motor learning the human is capable of achieving very skilled behaviour, and through repetitive training a degree of automation can be expected[21].

8 Theories for Therapy

Physiotherapy after stroke improves motor function and enhances mobility [24—27]. Enhanced mobility contributes to recovery and it may therefore be assumed that physiotherapy after stroke is a promoter of recovery[24—28].

Different physiotherapy approaches have been introduced over the years. Some methods are based on reflex and hierarchical theories of motor control such as the model of Rood [29], the proprioceptive neuromuscular facilitation (PNF) technique [30] and models developed by Brunnstrom [31] and the Bobaths[32]. Others, such as the systems approach [21] and the Motor Relearning Programme (MRP)[33], rely on recent theories of motor control and principles of neural plasticity[21, 33—42]. Although all physiotherapy approaches improve motor function in one way or another, there is evidence to indicate that a task oriented approach is more favourable in the acute treatment of stroke[27—28].

This means that in the acute stage early mobilisation have been associated with a more rapid and improved motor function and balance [27, 43]. Mobilisation has not been associated with decreased morbidity or mortality[44]. Also, exercises related to task oriented daily life activities like transfers, walking, reaching and balance activities improve motor function and is associated with a more rapid progress of improvement in the acute stage[45—46].

The improved function in the early stages of stroke is

not self-supportive but will degenerate if not maintained[47—48]. Several studies have shown a reduction of motor and ADL function post-stroke when rehabilitation has been terminated[47—49].

People who have had a recent stroke are more likely to maintain their ability to carry out daily activities if they receive therapy services at home. A review of 14 studies, involving 1617 participants, found that people who had a recent stroke were more independent in personal activities of daily living and more likely to maintain these abilities if they received therapy services at home. The amount of benefit that can be achieved, however, is uncertain[50].

The importance of maintaining body functions in order to be independent in activities of daily living and social participation is evident in persons post stroke, as for their healthy counterparts[27, 48].Local therapies directed at improving fitness, balance and strength indicate good results[51—56].

Other important aspect of exercise, apart from type of exercise is intensity of exercise. There are indications that a more intensive programme, that is a higher load of exercise intensity, will have a more favorable effect in regard to increased function both on body structure levels and activity levels[57—59, 10]. Exercise principles in general in regard to frequency (how often), intensity (how hard) and time (how long) are all important aspects of physiotherapy besides type of exercises [60]. This is especially important when trying to improve body functions like endurance and strength, but also in regards to activities like walking/walking capacity, and transfers.

There seem, however, to be poor or no transfer of these effects from body function levels to activity levels; which means that if you exercise strength in a leg press, this does not automatically improve your sit to stand ability. In order to improve these activities special focus need to be directed towards exercising these objectives.

The development of National guidelines can standardize and structure clinical practice so that the best evidence based treatment is available and equal for the patients on a national level.

9 Conclusion

Evidence based medicine and evidence based practice is important in order to achieve best treatment methods for persons in need of rehabilitation and physiotherapy.

Physiotherapy for persons with stroke is a driver of rehabilitation and task oriented exercises are preferable in the acute stage and there seem to be indications for follow-up rehabilitation in order to maintain capacity and function.

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