S troke rehabilitation has been revolutionized in the last decade through a combination of new imaging techniques looking at brain recovery and clinical trials into what is working in stroke rehabilitation. The fear that rehabilitation was a long way from being rooted in science has been overcome by an increasing understanding of neuronal recovery processes and their modulation by various physical and pharmacological interventions. More than 300 randomized controlled trials provide a sound foundation for evidence-based practice in stroke rehabilitation, supplementing and often confirming decades of clinical experience. This growing body of knowledge has been enriched by several studies in 2003. Advances in basic sciences and clinical research are beginning to merge and show that the human brain is capable of significant recovery after stroke, provided that the appropriate treatments and stimuli are applied in adequate amounts and at the right time. What is particularly exciting is the introductions of new technologies such as robotic enhancement of therapies and virtual reality to further enhance that recovery.

Intensity Versus Task-Specificity After Stroke

Stroke rehabilitation is therapy intensive and one of the unresolved debates has been around the issues of quality and quantity. Evidence is building that intensity of therapy is important. This is particularly true for language recovery. Bhogal et al identified 8 randomized controlled trials (RCTs), which compared the intensity of speech and language therapy (SLT) delivered by a trained therapist versus a non-therapist or a non-SLT control. Four of the studies were positive and these studies provided a mean of 8.8 hours of therapy per week for 11.2 weeks when compared with the 4 negative trials that provide approximately 2 hours of therapy per week for a total of 22.9 weeks. On average, positive RCTs provided 98.4 hours of therapy over half the time that the negative RCTs provided 43.6 hours. Intensive therapy is required to achieve optimal speech outcomes and produce significant improvements in language. The picture is not as clear for physiotherapy and occupational therapy interventions, where recent studies have shown little benefit from “intensive” therapy on arm function or general functional abilities. However, the intensity of treatment provided in the active limb of these studies is a subject for debate. Evidence from the bulk of clinical and functional imaging studies suggest that more intense therapy over a shorter period of time provides a better outcome.

In addition to quantity, the quality of interventions is equally important. Evidence suggests that the nature of interventions is important. Little benefits were seen with treatments such as repetitive training or resistance strengthening exercises. On the other hand, task-specific therapy in which treatment is specifically designed to deal with lost abilities or tasks showed best results. An excellent example of this is left-sided neglect, where task-specific training (enhanced visual scanning techniques) improves visual neglect with associated improvements in function. Similarly, short periods of prism adaptation improve not only visual neglect for several days but also perception of contralateral tactile stimuli. Page, on reviewing the evidence in favor of less-intensive, task-specific rehabilitation treatments, argued that intensity did not need to be altered to result in significant clinical improvements. This is supported by a recent study showing that increased use of the paretic hand recruited previously silent ipsilateral corticospinal pathways even in poorly recovered stroke patients. Hence, task-specific approaches, especially with stroke motor therapy, can be more efficacious than traditional approaches, which focus on impairment.

Robotic-Assisted Rehabilitation

In an attempt to supplement the use of therapists in providing a more intensive therapeutic environment, there has been increasing interest in the use of robotics in stroke rehabilitation. Volpe et al and Krebs et al have noted that robot-aided sensorimotor training, especially in the upper extremity, has been showing data consistent with other controlled studies that demonstrate that more activity leads to greater motor recovery and that such recovery is sustained over the long-term and is limb and muscle group specific. Fasoli et al actually showed that robotic therapy, which involved goal-directed planar reaching tasks to exercise the hemiparetic shoulder and elbow, reduced motor impairment in chronic stroke patients with moderate to severe impairments. Robotic devices provide a means by which therapists can increase the amount and intensity of movement of the plegic limb, allowing them to focus more time on more task-specific and complex functional movements. Lum et al has noted that efforts to bring these devices to the commercial market are underway. Similar albeit less complicated uses of computers to facilitate rehabilitation activities are becoming more commonplace.
Sensory Stimulation Facilitates Recovery

The importance of sensory stimulation in stimulating the brain and facilitating recovery has been shown with functional MRI and is likely the physiological underpinning for the use of acupuncture and TENS for facilitating motor recovery. Several modalities of sensory input (optokinetic, neck proprioceptive, vestibular, attentional, somatosensory-magnetic) have been investigated and shown to result in dramatic improvements in patients with neglect.15 There continues to be debate about the pathways involved; a recent study demonstrated that subconscious proprioceptive afferent information was as effective as exteroceptive somatosensory stimulation for improving hemispatial neglect, even when severe somatosensory loss was present.16 More intermittent pneumatic compression results in dramatically greater improvements in somatosensation.17

Virtual Reality and Motor Imagery

One of the newest potential therapies currently under study is virtual reality as a training tool in stroke rehabilitation. Virtual reality is computer technology that simulates real-life learning and allows for increased intensity of training while providing augmented sensory feedback.18

An even more interesting concept that is being used in rehabilitation is the concept of motor imagery, which is being incorporated into rehabilitation trials, particularly for motor retraining of hemiparetic limbs. It has been shown that motor imagery can result in increased functional MRI activity, a potential precursor of recovery. Stevens et al19 in 2 chronic hemiparetic stroke survivors used imagination and mirrors to trick patients’ brains into thinking that they were moving their arms and legs. Patients underwent intensive training utilizing motor imagery consisting of imagined wrist movements and mental stimulations of reaching and object manipulation using a mirror box whereby they move their unaffected limbs in a mirror but which appears like they are moving their affected limb. In addition, patients were told to imagine that they were moving their paralyzed limb. Patients who used this technique showed improvement in the motor function of the paretic limb.

Extended Therapy Helps Stroke Survivors Regain Mobility

Duncan et al20 found that a structured and progressive program of physical therapy in stroke survivors who were living in the community and had completed acute stroke rehabilitation allowed for continued improvements in lost mobility, balance, and endurance. The authors concluded that a home-based exercise program that was more aggressive than what is typically prescribed for stroke survivors who are discharged home can improve walking, balance, and cardiovascular endurance beyond that attributable to spontaneous recovery and usual care. More recently, a study in patients 6 months to 7 years after stroke showed that 12 hours of sensory or motor training significantly improved task-specific functional abilities.21 The concept that intensive therapy provides improved outcomes extends even into the outpatient phase of rehabilitation.

Home-Based Rehabilitation

Fjaertoft et al22 in a follow-up to a previous trial23 evaluated the long-term effects of an extended stroke unit service (ESUS). The ESUS consisted of stroke unit care with the addition of a mobile interdisciplinary team which coordinated early supported discharge and further rehabilitation in the home. Patients were randomized to stroke unit care or the ESUS and follow-up provided at 52 weeks. Although there were no significant differences in the Barthel Score or their final residence, more patients were deemed to be independent as measured by a Rankin score ≤2. Patients with moderate to severe strokes seemed to benefit the most. Determinants of successful domiciliary rehabilitation include less disabled and younger patients, absence of cognitive impairments, premorbid functional status, and early initiation of rehabilitative procedures. Teng et al24 in a cost analysis of an earlier study25 reported that an early supported discharge program for high-functioning stroke patients was a cost-effective alternative to usual care. Disler and Wade26 have noted that the concept of early supported discharge remains a promising one and not surprisingly reduces hospital lengths of stay, but the available data do not yet support or condemn the practice and many questions remain unanswered. Nevertheless, the trend toward moving stroke rehabilitation into the community faster for certain patients is likely to continue.

Conclusions

This is an exciting time in stroke rehabilitation. There is a real sense in the research community that stroke rehabilitation is beginning to realize its potential and the concepts of intensity of therapy, task-specific training, and increased sensory stimulation are now being supported by strong scientific evidence. The potential for using technology to assist in the rehabilitation process is now beginning to be realized. There is also a trend toward moving interdisciplinary stroke rehabilitation increasingly out into the community. Although this decade began with the promise of thrombolytics, increasingly it appears that the future of stroke care will be with the refinement and improvement of rehabilitation therapies.

References


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Robert W. Teasell and Lalit Kalra

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