

Stroke rehabilitation and recovery

Abstract

Stroke is the UK's leading cause of disability. Stroke rehabilitation can maximise recovery and improve quality of life. This article discusses some post-stroke impairments, including hemiplegia, dysphagia, communication impairments and neglect, and how rehabilitation can address these. Developing techniques of adaptation or compensation is vital, since the extent of stroke recovery is dependent on successful neuroplasticity, with healthy neurons adapting to compensate for damaged ones.

Key words: Communication impairment; Dysphagia; Hemiplegia; Neglect; Rehabilitation; Stroke

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Stroke is the UK's leading cause of disability, affecting 100 000 people per annum (Stroke Association, 2021). In England, Wales and Northern Ireland, the total cost of health and social care for patients with acute stroke is £3.6 billion in the first 5 years post admission (Xu et al, 2017), in addition to the non-quantifiable costs to the individual and family.

Post-acute stroke rehabilitation should start as soon as it is safe and possible. It can be offered in an inpatient or community setting, depending on the extent of post-stroke impairment.

Impact of impairments on recovery

Starting stroke rehabilitation early minimises impairment and post-stroke complications (Prvu Bettger et al, 2013). Impairment is the loss or abnormality of psychological, physiological or anatomical structure or function. Disability is the restriction or lack of ability to perform an activity in the conventional manner, because of an impairment (United Nations, 2003–4).

Stroke recovery depends on multiple factors, including age, gender, premorbid functional level and socioeconomic status; with older people, women and those in lower socioeconomic groups, often with additional comorbidities, having poorer post-stroke outcomes (Alawieh et al, 2018). In the post-acute stage, younger patients with haemorrhagic strokes and with no additional risk factors tend to have a swifter recovery and better neurological prognosis than those with comparable ischaemic strokes (Paolucci et al, 2003).

Recovery is a continuum, rather than the complete resumption of premorbid function, as often perceived by patients and their families. Stroke rehabilitation focuses on maximising recovery through adaptation or compensation, restitution or restoration and neuroplasticity (Belagaje, 2017). Adaptation or compensation is adopting an alternative strategy to completing a task, for example, using the unaffected hand to feed when this hand was not used previously, or using a walking aid to facilitate ambulatory mobility. Restoration or restitution seeks to restore function of damaged brain tissue, primarily through neuroplasticity. Stroke recovery is determined by the extent of successful neuroplasticity; healthy neurons adapting to compensate for damaged neurons. Neuroplasticity is an evolving research area: not all neuroplasticity is useful or of functional benefit and genetic variation may contribute to neuroplasticity (Stewart Campbell and Cramer, 2017). Neural recovery and reorganisation tends to have reached its maximum by the 6-month post-stroke period, although patients can demonstrate improvements beyond this stage. Hence, interdisciplinary rehabilitation during this stage is crucial (Belagaje, 2017).

General principles of rehabilitation

Goal setting is a crucial element of the stroke rehabilitation process. This is primarily achieved via motor learning. It consolidates task and context for specific patient-centred

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activities. By supporting patients in replicating individually relevant activities, it also ensures that rehabilitation is appropriately designed to attain specific and directed goals. Ideally, these should occur within the patient's own surroundings (Rice et al, 2017). While this cannot be facilitated by an inpatient therapy team, there can be opportunities to replicate the patient's home environment. Rehabilitation offers the opportunity for graded discharge, with home leave at weekends or overnight. This enables patients to practise skills in a familiar environment and give feedback to allow challenges to be addressed before discharge.

Rehabilitation qualifies and demonstrates functional improvement by using impairment scales. The most used scales are the Functional Independence and Functional Assessment Measure (conventionally referred to as FIM+FAM). This compares the extent of a patient's independence and level of support required in multiple domains, both practical (for example, washing, grooming, communication) and neuropsychological (for example, safety awareness, social interaction and concentration) at admission compared to discharge (Nayar et al, 2016). The support required can vary from a patient using written prompts to complete a task to requiring another person to offer full assistance.

Hemiplegia or hemiparesis

Goals for motor recovery include achieving maximal independence with transfers from one position to another, mobility (which can include use of a walking aid), and upper limb activities (generally related to grooming and domestic tasks).

Structured rehabilitation is the most successfully proven management of stroke-related motor impairments. Motor weakness is the result of damage to the corticospinal tract, which travel from the primary cortex to the spinal cord. This is the major neuronal pathway is responsible for voluntary skilled movements. Task-related exercises enhance recovery, which occurs as a result of neuroplasticity, augmented by training of pre-existing corticocortical connections (Krakauer, 2006), enabling functional improvements.

Lower limb motor recovery following a stroke tends to be optimal by the end of the immediate post-stroke 6-month period, relative to the extent of corticospinal tract injury. Research into the use of radiological biomarkers to predict motor recovery shows promise, although these have not yet found their way into everyday clinical practice.

Upper extremity recovery is generally slower than lower limb recovery (Smith et al, 2017) and up to 50% of patients also experience post-stroke upper extremity pain, which can be difficult to manage, further limiting rehabilitation and recovery. Subluxation secondary to shoulder girdle weakness and contractures can also present additional challenges to recovery. Left hemisphere stroke is associated with better upper limb recovery and the greater the degree of upper limb impairment, the poorer the neurological prognosis. However, this does not preclude offering specialist neurorehabilitation to this patient group, as there is scope for reducing the impact of longer-term disability (Hattem et al, 2016).

Dysphagia

Goals for post-stroke dysphagia therapy focus on adaptation or compensatory mechanisms and aim to reduce the risk of lower respiratory tract infections, often by modifying fluid and food consistency, while still ensuring optimal nutrition (Singh and Hamdy, 2006). Gastrostomies are an option for those unable to achieve sufficiently safe swallow and to maintain nutrition, although these confer an additional care burden. Post-stroke dysphagia increases mortality risk by 8.5, so treating this is an important component of stroke rehabilitation for the up to 50% of post-stroke survivors it affects (Martino et al, 2005).

Dysphagia is not a distinct lateralising sign. Multiple areas of the brain have been implicated spanning the fronto-parieto-temporal cortex and subcortical white matter tracts (Wilmskoetter et al, 2019). For most patients, recovery occurs to a safe level within 1–2 months post-stroke, dependent upon reorganisation and increased involvement of projections from the unaffected motor cortex (Hamdy et al, 2001). Between 11% and 50% of patients continue to have dysphagia 6 months post stroke (Mann et al, 2000). In patients

with pre-existing chronic lung disease, post-stroke aspiration can also occur secondary to an inability to maintain sufficient apnoea when swallowing.

Bedside assessments are limited and do not exclude silent aspiration, so further radiological investigation is the preferred method to better assess swallow and aspiration risk. Common investigations included videofluoroscopy (enabling visualisation of the oropharyngeal phase of swallowing) or modified barium swallow (barium mixed with varying consistencies of fluid and food is visualised and quantified as it travels from the oral cavity to the oesophagus). However, barium swallow exposes the patient to radiation and there is no defined protocol for volumes or consistencies delivered. Fiberoptic endoscopic evaluation of swallowing is increasingly viewed as the gold standard. It enables an endoscopic view, through use of a nasoendoscope, via the uvula to the hypopharynx and larynx, assessing anatomy and sensory response to variable consistencies. This can be performed at the bedside, including with normal meals, and is becoming the mainstay of dysphagia assessment.

Dysphagia also affects psychological wellbeing and impacts social interaction, as patients feel less able to participate in social events, where food is often a central feature.

Communication impairments

Stroke-associated communication impairments affect approximately one-third of stroke survivors and can prove a barrier to rehabilitation, leaving patients despondent about their actual or potential progress. As a result, early intervention is crucial.

Perhaps more than other areas, the rehabilitation goals of post-stroke communication impairment are personal and individual. A patient who delivers presentations as part of their work or a patient who does not engage with technology will both need to be offered a means by which they can continue to access personally meaningful activities. The full assessment involved in defining the type and extent of post-stroke communication impairments and range of interventions is beyond the scope of this article, so only a brief overview is offered.

A stroke can affect language expression and understanding (aphasia), planning and coordination of speech, so the individual knows what they want to say but is unable to articulate it (apraxia of speech) or motor patterns (dysarthria). The latter can be associated with cerebellar syndromes and strokes affecting the brainstem. Broca's area or the left posterior inferior frontal gyrus is responsible for understanding of and production of language. Damage to Broca's area is also associated with apraxia (Hillis et al, 2004). Wernicke's area or the superior temporal cortex is associated with language reception and processing (González-Fernández et al, 2015). Cognitive impairment, discussed later on, can further compound communication impairment and contribute negatively to the learning adaptive techniques.

Predicting recovery of post-stroke communication impairment is more difficult than limb weakness or dysphagia, because of the potential involvement of multiple regions of the brain and influence of other factors, including age and level of education. Younger people's brains are more plastic and older people tend to recover less well from post-stroke aphasia. However, a higher burden of cerebrovascular comorbidities, more likely among older people, is also associated with increasing rates of aphasia and dysarthria. Level of educational attainment is also likely to influence stroke recovery, with increasing years (≥ 12) of education potentially being protective against post-stroke aphasia (González-Fernández et al, 2011).

Nonetheless, as for limb weakness, optimal recovery from post-stroke aphasia appears to occur within the first 90 days, with patients achieving up to 70% of their maximal recovery during this timeframe (Lazar et al, 2010).

Vision

Up to 40% of stroke survivors engaged in inpatient neurorehabilitation have visual impairment (Hepworth et al, 2015) and stroke can affect vision and eye movement in multiple ways. Damage to the parietal lobe can present with loss of superior contralateral vision.

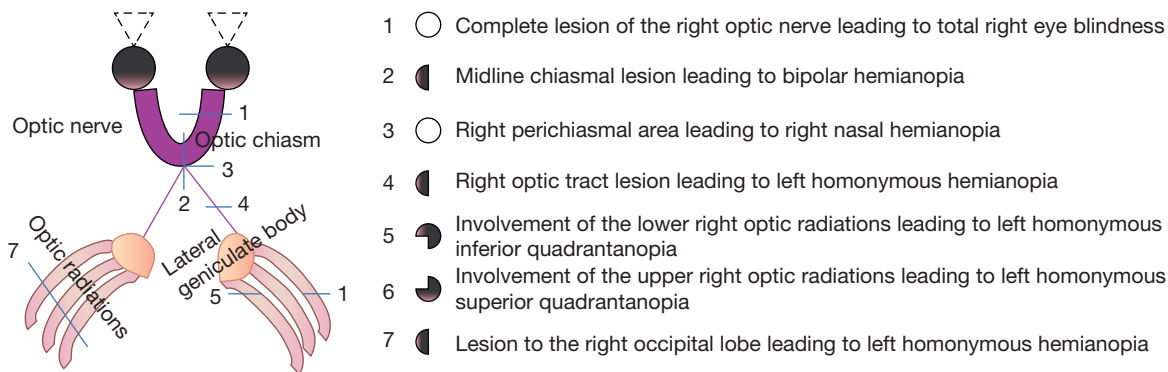


Figure 1. Visual field defects and their manifestations.

Inferior contralateral vision loss can be the result of damage to optic radiations passing through the temporal lobe (Figure 1). Contralateral homonymous hemianopia can occur secondary to stroke affecting the carotid and middle cerebral artery territories. The latter can also be responsible for contralateral homonymous hemianopsia. Cerebellar syndromes can cause nystagmus and conjugate eye deviation can be secondary to strokes within the region of the anterior cerebral artery. The basilar artery is implicated in conjugate eye deviation.

Given the varied nature of potential post-stroke ocular impairments, it is not possible to offer a standard approach, with the exception of nystagmus. This can potentially be treated pharmacologically, most commonly using baclofen or gabapentin.

Other visual disorders are managed via substitutive treatment, ie a prism for diplopia, or teaching patients compensatory techniques. This can include adaptive alternative head postures, low vision devices (for example magnifiers) or appropriate use of lighting. Practical approaches are also useful, for example ensuring patients have access to their glasses or are offered a visual acuity assessment following a stroke. Ptosis secondary to full or partial CNIII palsy in patients with strokes affecting the mid-brain is generally managed with botulinum toxin A injections, with surgical management rarely offered. Other visuo-perception defects, such as object agnosia secondary to lesions affecting the parietooccipital cortex, may respond spontaneously, although patients benefit from appropriate education, reassurance and being equipped with coping strategies (Mann et al, 2000). This is true of visual rehabilitation for all post-stroke visual impairments. Patient education is as important as exploring options to increase independence, with modern technology offering additional options, for example text-to-speech and interactive maps on smartphones.

Neglect

This is a neuropsychological syndrome occurring as a result of damage to the cortex of the non-dominant hemisphere. Patients have a lack of visuospatial awareness and lack of attention. It is more frequent among patients with right hemispheric lesions, resulting in left-sided neglect, which is more chronic and has adverse impacts on activities of daily living. It can also indicate adverse prognosis, particularly in older patients with right hemispheric strokes (Gottesman et al, 2008). It differs from visual field defects, in that an entire spatial area is affected and can be divided into the spatial domains affected: personal (body), peripersonal (reaching) and extrapersonal (far-reaching) (Spaccavento et al, 2017). It might affect up to 80% of stroke survivors and poses challenges in rehabilitation, as patients are unable to complete tasks appropriately, for example may neglect to wash or shave part of their face or not notice obstacles when mobilising, be this whether ambulant or using a wheelchair.

Neglect requires additional patient and caregiver education. An interdisciplinary approach offers scope for improvement. This includes visual scanning therapy and, increasingly, use of dopaminergic agents, in particular rotigotine. Dopamine agonists are thought to enhance spatial working memory and selective attention (Gorgoraptis et al, 2012). While neither approach is curative, they better facilitate adaptation or compensation, and offer potential for improved quality of life and greater independence.

Post-stroke depression

Post-stroke depression affects over one-third of stroke survivors and is associated with poorer outcomes. It is not necessarily an inevitable sequelae following stroke. Larger lesions and those located within the left hemisphere have been postulated as being risk factors for post-stroke depression (Bhogal et al, 2004), although the diagnosis should be considered in patients who present with social withdrawal, loss of appetite and anhedonia, who did not exhibit these symptoms before the stroke. Post-stroke depression will interfere with progress in rehabilitation, negatively impacting on engagement in the rehabilitation process.

While post-stroke depression presents more commonly in older people, a Swedish study found that younger people with post-stroke depression are more likely to attempt suicide (Eriksson et al, 2015).

Early liaison with psychology and psychiatry colleagues can better formulate the diagnosis and institute a management plan. Selective serotonin-reuptake inhibitors may be associated with neurogenesis and reduction in neural inflammation. In patients with haemorrhagic strokes or those on concomitant antiplatelet or anticoagulation therapy, there is often valid concern about increased bleeding risk with co-prescription of a selective serotonin-reuptake inhibitor. Certainly, the risk of bleeding is increased in those co-prescribed anticoagulant treatment, so caution is advised. Selective serotonin-reuptake inhibitors might increase gastric acid production and thereby increase risk of upper gastrointestinal bleeding. Co-prescription of a proton pump inhibitor can ameliorate this risk.

Mirtazapine (a noradrenaline and selective serotonin antagonist) might be associated with a decreased bleeding risk, although the side-effect of weight gain and its associated risks, including hyperlipidaemia, need to be considered, with appropriate consideration of risks vs benefits (Cramer, 2015).

In patients for whom it is felt that the risks of antidepressants outweigh the benefits, cognitive behavioural therapy may be useful on its own, although this requires a personalised approach and research as to its efficacy is sparse.

Managing post-stroke depression often involves educating the patient's friends and family, encouraging pursuit of enjoyable activities and facilitating peer support.

Ultimately, recovery from stroke can be a long, arduous process. Nonetheless, there may still be opportunities for patients to be offered opportunities to encourage appropriate levels of independence with activities of daily living.

Patients will likely benefit from education, both about the nature of the stroke and the benefits of rehabilitation. In multicultural environments, English proficiency among patients can be variable, so additional care must be taken to ensure that information is delivered in the patient's first language. Conventional wisdom dictates that rest and recuperation will aid recovery following acute illness, although the converse is true for stroke. Increasingly, the benefits of recreational activity are also being recognised as an integral part of rehabilitation.

These opportunities for social interaction with others facing similar challenges help combat loneliness and enhance opportunities for learning (Luker et al, 2015), so can also help manage symptoms of post-stroke depression.

Conclusions

Stroke can present with multiple deficits and complications, although a measured approach and interdisciplinary working can facilitate an appropriate approach to rehabilitation. Stroke rehabilitation offers the potential for improved quality of life and greater independence, via an interdisciplinary and holistic approach, even in the face of chronic impairments. A considered, goal-centred approach allows healthcare professionals to work with patients in a meaningful manner, so that patients are better able to manage their condition. Consequently, the importance of educating both patients and caregivers is vital. Patients and their caregivers need to have a clear and realistic understanding of the reasons for the particular impairment and the approaches to help address this, so that they are better able to manage life post-stroke.

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Key points

- Stroke is the leading cause of disability in the UK.
- Structured rehabilitation offers the best hope of achieving improvement in impairments.
- Stroke rehabilitation aims to maximise recovery through adaptation, restitution and, ultimately, neuroplasticity.
- Motor recovery, particularly of the upper extremity, tends to be relatively predictable in the immediate 6-month post-stroke period, as this is linked to the extent of corticospinal injury.
- Post-stroke depression can affect up to one-third of patients and an individualised approach is often needed.
- Post-stroke neglect can be associated with poor prognosis, although it can be managed via visual scanning therapy and dopamine agonists.
- Predicting recovery from post-stroke communication impairment can be difficult, as it is multifactorial, both in terms of patient-specific factors and possible involvement of multiple regions of the brain.

Conflicts of interest

The authors declare that there are no conflicts of interest.

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