1. Stroke and recovery

1.1 Causes of stroke

A stroke or cerebral vascular accident is caused by an interruption in the supply of blood to the brain. It occurs when an artery supplying blood to the brain either becomes blocked or bursts.

If brain cells lose their supply of oxygen and nutrients, they temporarily stop working or die. Cell death results in areas of localised necrosis known as cerebral infarcts. However, there are many remaining cells. If the person is properly handled after he has had a stroke, many lost movements can be regained.

The many causes of stroke include cerebral infarcts, high blood pressure, cerebral haemorrhage, malformation of the blood vessels, brain tumours, traumas, and other miscellaneous conditions.

Virtually all cerebral infarcts result from two pathological processes: thrombosis and embolism.

A thrombosis is a blockage in an artery of the brain caused by a solid blood clot or thrombus that forms within the blood vessel system.

An embolism is a blockage caused by a detached fragment of thrombus (or other material) that has formed somewhere else and is carried by the bloodstream to the brain.

1.2 Effects of stroke

Since each half of the brain supervises and controls the activity of the opposite side of the body, any damage to one side of the brain will lead to a disability to the opposite side of the body. Thus, a stroke on the left side of the brain affects the right side of the body and vice versa. The following difficulties may be experienced by someone who has had a stroke:-

- Loss of normal controlled movements
  The vital changed function that all stroke patients suffer is the loss of normal skeletal muscle tone\(^1\) on the affected side. When normal muscle tone is altered the person cannot carry out normal controlled movements. Postural muscle tone may be increased, decreased or both. When muscle tone is increased it is described as spasticity, or hypertonicity. Where it is decreased it is known as flaccidity or hypotonicity.

  The lack of controlled movement limits the person’s ability to carry out daily living tasks. It can lead to other secondary problems if it is not treated correctly from the
start. It can result in pressure sores, chest infections and constipation. Blood clots may form in the leg which then move up to the lungs to cause a pulmonary embolism.

- **Swallowing difficulties**
  Difficulty in swallowing may result from weakness in the muscles of the face, jaw and tongue. This can cause hunger and discomfort.

- **Incontinence**
  Incontinence of the bladder and the bowel commonly occurs after a stroke. Control of the bladder and the bowels improves and usually normal function returns.

- **Sensory problems**
  The damage to the brain may cause not only the obvious physical disability but also perception difficulties and loss of sensory discrimination. As a result, someone who has had a stroke may have difficulty knowing where her limbs are and in what position her body is in e.g. whether it is bent or straight.

  Also, depending on the part of the brain affected, the person may experience problems with touch, sight, hearing, speech, smell and balance. The main problems associated with sensory and proprioceptive loss are described in section 18.4 at the end of this guide.

- **Psychological and emotional problems**
  Someone who has had a stroke may become depressed, anxious or suffer mood swings in learning how to cope. This may be a natural response to the person’s changed circumstances rather than something actually caused by the stroke.

- **Problems with understanding**
  Memory, concentration and the understanding of spatial concepts (e.g. in/out) may be affected.

- **Social consequences of stroke**
  Following a stroke there may be subtle and major changes in the relationships between the person who has had the stroke and their family members. Stroke can lead to isolation within the family and in the community. There is often a drop in family income.

**Note:** These additional difficulties which the patient may experience are described more fully in chapter 18
1.3 What happens to a person after stroke?

An initial period of cerebral shock
A period of cerebral shock immediately follows a cerebral infarct. During this period, which can vary in time from a few days to few weeks, the person's muscle tone is flaccid (hypotonic). Movement of the affected side is difficult, if not impossible. This includes movement of the muscles of the face, tongue, trunk and limbs.

The Recovery Phase
Following this period of cerebral shock, a recovery phase begins. It usually starts between the second and sixth week after the stroke. The recovery phase may progress in three different stages. The length of time for each stage is different in each person. Also, a clear beginning and end of a stage cannot be seen. Often the different stages can be present at the same time in the different parts of the affected side. A description of each stage is given below.

Stages in the Recovery Phase

1. Persistence of hypotonicity (the flaccid stage)
   In some people this may last a long time. In this stage, the motor loss is usually accompanied by a severe sensory loss. The person’s arm is limp and floppy and cannot be supported in space because of muscle weakness and low tone. This is the most disabling stage of the three.
   Very few people who have had a stroke remain flaccid forever and some degree of spasticity is almost always present. Even if the arm seems to be completely flaccid it usually demonstrates "flexor spasm" (see fig. a, page 5) in the fingers when strong stretch is applied and held. If the leg seems to be completely flaccid when at rest, passive bending of the hip and knee meets mild resistance when the person lies on his back; a position which increases the tone when spasticity is present.

2. Evolution towards normal tone (the recovery stage)
   Movements start again in the limbs, first at distal level (the hand and arm before the shoulder, the foot and leg before the hip). Movement is often earlier in the upper limb and follows a normal pattern. Despite the stroke killing a number of brain cells the remaining cells are able to take over and lost movements are regained. However, a slight disability usually remains.

3. Evolution towards hypertonicity (the spastic stage)
   The recovery of motor function with an evolution towards spasticity is the most frequent occurrence. There is initial recovery of the proximal movements of the limbs (hip and shoulder). This occurs earlier in the lower limb, following the typical spasm pattern of hypertonicity (see fig. a, page 5), and progresses towards spasticity.
Increased tone leading to spasticity is seen in many muscles at the same time, particularly in the stronger muscles of the body, known as “antigravity muscles” i.e. those muscles which are used to lift the body and to carry weight against gravity. This developing spasticity in the antigravity muscles together with the inability to initiate movement on the affected side is responsible for asymmetry, lack of rotation, no body adaptation to gravity, no graduation of movement and no protective extension of the arm.

Muscle tone will be different in each individual person. Its state will condition the quality of movement as follows:-

- with **severe spasticity**: movements are difficult if not impossible because of the state of continuous muscular contraction;

- with **moderate spasticity**: movements will be slow and are performed with strain and abnormal co-ordination;

- with **slight spasticity**: gross movements of the limbs are possible whilst the fine movements of the hand are difficult.

4. Ataxia

In a few cases of hemiplegia, (mainly those caused by trauma) the cerebellum or cerebellar system may be affected. This results in ataxia. The person’s movements become uncontrolled and excessive. There are difficulties in performing and maintaining the intermediate positions of a movement. Voluntary attempts carried out by the person to solve these problems cause intentional tremor and dysmetria.
The typical spasm pattern of stroke

Fig. a illustrates the “typical spasm pattern” caused by the increased muscle tone in the antigravity muscles if it progresses towards severe spasticity:

- Shoulder drawn backward and downward, arm turned inward
- Elbow bent usually accompanied by fisted hand, palm down (see “hand spasm” fig. 92)
- Pelvis drawn backward with the leg\(^3\) turned inward (during the flaccid stage, with the reduction of the muscle tone the leg falls to the outside with the knee bent)
- Hip, knee and ankle straightened
- Foot stiffened downward and turned inward
- Lateral trunk shortening

Spasticity must be prevented during the entire rehabilitation programme using the “anti-spasm or recovery pattern” at all times (Fig. b). Example: if a person is developing “spasticity in flexion” in the arm (arm turned in, elbow bent, fisted hand palm down), the anti-spasm pattern will be to position the arm turned out with the elbow and wrist straightened, hand palm up with the thumb and fingers opened. In other words, you must adopt the opposite patterns. From the day of onset of the paralysis the person must be placed in the “anti-spasm pattern” and all the exercises must lead into recovery patterns. Particular attention must be given to the position of the shoulder and the hip (see next sections).

- Shoulder forward with the arm turned outward
- Elbow straightened, hand palm up with the fingers open, thumb away from the index finger
- Pelvis drawn forward with the leg turned to the inside
- Hip, knee and ankle slightly bent
- Elongation of the trunk
1.4 Factors that influence the recovery

Some people will make almost a complete recovery from a stroke, others may still have considerable difficulties one year on. There are a number of factors that can influence the outcome as follows:-

- **Quality of the rehabilitation treatment**
  Whilst the degree of recovery is dependent upon the extent and location of the stroke it is very much influenced by the quality of the treatment received in hospital and at home. This includes prevention and treatment of complications (bowel trouble, contractures, retraction, pressure sores etc.) which can increase the damage caused by the stroke. **The first weeks after a stroke are crucial.** During this period it is important to stimulate and use the potential the person has to be rehabilitated.

- **The motivation of the patient and his family**
  The motivation of the individual and the support of family and friends will also determine the degree of recovery. A person who is motivated to do activities such as feeding, dressing, washing, can use movements in these activities which will help recovery to occur. The quality of care and encouragement given by family members can make a real difference.

- **Age of the patient**
  Young people are more likely to make a better recovery than people over sixty years of age. This is due to additional problems in the elderly (e.g. cardiac, circulatory, respiratory, psychological and family problems).

- **Persistence of the flaccid stage and delay in treatment**
  These have a negative influence on recovery from the stroke.

1.5 Treatment guidelines

**Starting treatment**
Rehabilitation must begin in the early stages of the stroke. During the acute phase medical lifesaving management takes priority. However, great care must be taken to prevent contractures and pressure sores through correct bed positioning and range of motion activities. As soon as the person is medically stable, active treatment should begin. Treatment must be early, intensive, and repetitive if worthwhile results are to be obtained.

The aim of early treatment is to:

- **prevent the development of abnormal patterns of movement** which result from abnormal muscle tone;
- **teach the person not to compensate in unnecessary and potentially harmful ways with his unaffected side.** In the early stages of recovery if the individual
compensates with the unaffected side this may increase spasticity, provoke abnormal “associated reactions” and also discourage the use of the affected side.

**Stages in the treatment programme**

The *direction* of development of controlled movement is **from proximal to distal**. Thus controlled movements of the upper trunk and shoulder and the lower trunk and hip should be established first.

All movements of the affected limbs should be performed through the following progressive stages: **passive movement**, **assisted active movement** and **active movement**. After this, the person will be able to place his limb and hold it in space. If there is sufficient recovery, strengthening with **resistive exercises** can follow.

Progress in stroke rehabilitation is generally made by **working through a sequence of exercise progressions** which closely follow the pattern of motor development acquired during the infant stage of life. For example: rolling → to sitting → to standing → to walking; or rolling → to prone → to propping → to crawling → to standing → to walking.

It is important to stimulate the person to carry out all the **activities of daily living** (see next section) in order to become as independent as possible. The person must learn to dress and undress, to feed himself, to be independent in personal hygiene and so on.

The last stage in rehabilitation will focus on the **controlled movement** of the hand. Precision movements of the hand can be established when controlled shoulder and elbow movements have been re-established and the hand is free from the “flexor grasp”.

**Use of sensory cues**

It is important to make use of sensory cues such as voice, touch and vision.

**Verbal input** will assist the treatment by providing auditory cues. The commands given by the trainer must be short and easily understood, leaving the person the time to understand. For example, ask the person to “think” about the movement: “we are going to bend and stretch your knee ....... look at your knee .......... now help me to do it ............ feel the movement.”.

**Visual input** also is important e.g. a long mirror placed in front of the person will provide a sensory cue.
1.6 Planning the rehabilitation programme

Setting goals
Start by undertaking a thorough evaluation and then establish realistic goals. No two people are the same. The person’s abilities must be assessed and re-assessed and treatment offered according to the findings. Treatment should be specifically designed to take into account all aspects of the person’s loss rather than the more obvious motor and sensory losses.

The goal of rehabilitation for someone who has had a stroke is to obtain the maximum degree of physical and psychological independence. The person should develop a level of functional independence not only in a sheltered environment such as a hospital but especially at home and in the community. This means that “treatment” must be carried out during every aspect of daily life, becoming a part of the daily routine and not performed as an isolated activity two or three times a week or when a rehabilitation worker visits the household.

It is active movement which promotes the recovery of functional abilities. Carrying out passive movements with the person lying in bed for months is a bad habit. Someone who has had a stroke should be helped to do normal daily activities, even if these are not done perfectly e.g.:

- getting up from bed in the morning requires bed mobility (section 8.4), rolling to the affected side (section 8.3), sitting up with leg out of bed (section 3.5), transfer from bed and sitting on a chair (section 4) etc.
- toileting (section 17.4) Instead of using the toilet by the bed or being half-dragged or carried to the toilet, the person who has had a stroke should be helped by the family trainer to go to the toilet. Walking (section 12.5) to the toilet thus becomes for the person part of “treatment”.
- sitting balance: the training activities suggested in section 9 are important for the restoration of sitting balance especially in the early stage after a stroke. Sitting and reaching for a comb or a game of cards placed on a table slightly to the affected side can accomplish the same objective. The added bonus is that these activities are part of the person’s daily routine.

Planning for progress
Select activities that the person can perform as well as skills that may advance her to a higher functional level. You can often break down a given activity into its component motions. The person should be encouraged to practice each component as an exercise. In the final stages of treatment, the activity can be practised in its entirety (e.g. the exercises listed in section 7 are useful at the start of treatment for the improvement of hip movements and control; bridging is a functional ability that follows this improvement and it is useful in nursing care, use of bed pan, dressing).

The capability of the individual
The frustration of failure must be avoided. Any progress in the program must be made within the person’s capability. For example, the person should learn to balance or stabilise in a position before asking her to move from that position.