Chapter 1

Cerebrovascular Diseases

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Organization of Stroke Care: Education, Stroke Units and Rehabilitation

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Introduction

Acute stroke is increasingly recognised as one of the leading factors of morbidity and mortality worldwide. Its economical burden is among the highest of all diseases. Ischaemic stroke is by far the most frequent subtype of acute stroke. More than 80% of all stroke patients suffer from focal ischaemia [Bonita, 1992]. Over the past decades, acute stroke has increasingly been recognised as a medical emergency. Acute, post-acute and rehabilitation care of stroke patients in specialised wards as well as revascularising therapies have been proven to be effective in acute ischaemic stroke.

There have been several publications of guidelines or consensus papers over the past years [Asplund et al., 1993; Brainin et al., 1997; Aboderin et al., 1996; Adams et al., 1994; The European Ad Hoc Consensus Group, 1996; 1997; Billier et al., 1998; Einhäupl et al., 1999; Feinberg et al., 1994; Gorelick et al., 1999; Report on Pan European Consensus Meeting on Stroke Management, 1995; WHO Task Force on Stroke and other Cerebrovascular Disorders, 1989]. This series of recommendations is proposed by the European Stroke Initiative, the common body of three major European neurological or stroke-related societies, the European Neurological Society ENS, the European Federation of Neurological Society EFNS and the European Stroke Council, which also represents the European Stroke Conference. In these recommendations, the authors provide both an overview of established or widely used therapeutic strategies as well as an evaluation of involving, but not yet proven strategies. Table 1 gives the definitions for levels of evidence used in these recommendations.

Table 1. Definitions for levels of evidence: modified from Adams et al. [1994]

Level I: highest level of evidence		
Source	1	primary end-point from randomised, double-blinded study with adequate sample size
	2	properly performed meta-analysis of qualitatively outstanding randomised trials
Level II: intermediate level of evidence		
Source	1	randomised, non-blinded studies
	2	small randomised trials
	3	pre-defined secondary end-points of large randomised trials
Level III: lower level of evidence		
Source	1	prospective case series with concurrent or historical control
	2	post hoc analyses of randomised trials
Level IV: undeterminated level of evidence		
Source	1	small case series without control, case reports
	2	general agreement despite of lack of scientific evidence from controlled trials

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Education

Public Education

Despite the high mortality and morbidity of stroke, many patients and relatives do not recognize the symptoms of stroke or realise that seeking treatment is urgent. Various factors are responsible for delay in patient referral to hospital. The National Stroke Association estimates that 40% of people in the USA do not know the warning signs of stroke, and only 1% know that stroke is a leading cause of death [Gorelick et al., 1999]. In Germany, it is estimated that only 5% of the population are aware of the warning signs of stroke compared with 50% who know about myocardial ischaemia.

Reasons for this shortcoming include a poor awareness of stroke by the victim or family, reluctance to seek immediate medical help, incorrect diagnosis by the paramedical service and rating stroke as a non-emergency by medical personnel and the family physician. These facts emphasise the need for an ongoing education program. The benefits of media campaigns to raise awareness of stroke have been documented in a number of studies [The European Ad Hoc Consensus Group, 1996; Alberts et al., 1992; Barsan et al., 1993; 1994]. Education programs can be extensive and involve radio and television interviews, newspaper articles, lectures to local and regional primary care and emergency department physicians, and mailings to local physicians. The aims of public education initiatives are to enable and encourage the general population to recognise immediately the symptoms of stroke, to realise that urgent medical atttention is needed, and to use the emergency transportation services and immediately go to the correct hospital. Primary contact with general practitioners (GPs) may cause delays and prevent early institution of adequate therapy. Teaching the public about symptoms and signs of stroke is one of the highest priorities of public medical education.

Professional Education

Professional groups who must be motivated in stroke care include emergency medicine physicians and technicians, other specialists, nurses, GPs and paramedical personnel. In many European countries neurologists are nowadays most interested in the care of stroke patients. Stroke units are frequently part of neurology departments. However, internists, geriatricians, GPs and emergency medicine physicians may also be responsible for treating stroke patients. Actually, due to the low number of neurologists or other stroke physicians in some European countries, many stroke patients are still not seen by a physician with special expertise in stroke management. Primary care physicians are not a target group for education campaigns at present, though increasing their general level of understanding of stroke is important, as they will be responsible for continuing the secondary prevention instituted after the acute phase.

Inaccurate initial diagnosis represents a major problem. Ambulance dispatchers may have a false-positive assessment rate of up to 50%, and even in trained paramedics, this rate is about 25% [Kothari et al., 1997]. However, this result can be improved by adequate training [Kothari et al., 1999].

Paramedics and physicians also need to be trained in the recognition of symptoms and signs of acute stroke and the necessity of immediate transportation to an adequately equipped unit. The medical personnel should be trained in recognising the acute presentations of ischaemic stroke and should be able to cope with the early complications after stroke. It should be noted here that there is no reliable way to differentiate between intracranial parenchymal haemorrhage and ischaemic stroke by clinical symptoms alone. Some signs of subarachnoid haemorrhage, another presentation of acute stroke, however, may allow for early suspicion of this stroke subtype. Emergency medical personal should be trained to conduct a focussed medical examination that includes level of consciousness, presence of focal weakness, presence of seizure activity and the presence of aphasia or other cognitive disturbances. They need to be informed that fluctuating or stuttering courses and even early clearing of systems are of special importance. They need to learn about the complexity of stroke presentation and its differential diagnosis in order to understand why early involvement of specialists in this field is desirable. It is particularly important that these groups learn that they are important and competent partners in providing acute stroke care.

Stroke as an Emergency

Successful stroke care begins with recognising stroke as a medical emergency like acute myocardial infarction (MI) or severe trauma and, even more importantly, recognising that a patient presenting as a medical emergency has a stroke [Adams et al., 1994; The European Ad Hoc Consensus Group, 1996; Kothari et al., 1999]. There is wide-spread consensus among stroke physicians that the best way to provide early stroke care is to call the emergency medical system immediately and to get transported to an institution, where stroke care can be provided on an

adequate level. The corresponding emergency numbers should be called immediately, if stroke is suspected.

Cost considerations provide another incentive to regard stroke as an emergency. The total cost of stroke is about USD 30 billion/year in the USA and USD 1.9 billion/year in Sweden; in Canada the direct costs alone for 285 stroke patients were USD 6.6 million over a 2-year period. In Sweden, the cost of stroke patients from stroke to death have been calculated to be 73.000 USD, while in Finland it is 60.000 USD [Kaste et al., 1998]. Increasing the proportion of stroke patients with a favourable outcome will decrease costs, particularly the direct costs, which represent about 80% of the total costs [Kaste et al., 1998; Wade et al., 1985].

The initial evaluation of the stroke patients includes the assessment and breathing and circulation. Differential diagnoses that need to be considered are coma of other origin, trauma, drug overdose, post-seizure state or metabolic disorders. After ischaemic stroke, only very few patients develop depression in consciousness within the first 24 h. With early loss of consciousness, a diagnosis of an intracranial haemorrhage or one of the other differential diagnosis mentioned before is more probable [Hacke et al., 1995].

In the emergency room, stroke patients need to be tested for hemiparesis, aphasia, hemianopia, dysarthria, disturbance of coordination including ataxia and poor balance, double vision and oculomotor disturbances, nausea, vomiting, headache and neck stiffness. Stroke can present with different syndromes, depending on the part of the brain that is injured by ischemia. However, special syndromes are more frequent than others and should be recognised.

Referral

Stroke patients should be treated in specialised centres [Stroke Unit Trialist's Collaboration, 1997]. Such a centre is defined by both trained personnel and the capability to perform diagnostic studies without undue time delay. Minimum requirements of such centres are listed in table 2. They include 24-hour availability of CT scanning, stroke physicians and other specialised personel.

Stroke centres or stroke units are no stand-alone solutions. They can only work optimally if a well-established referral and rehabilitation network is available [The European Ad Hoc Consensus Group, 1996]. This also includes co-operation with primary care physicians in primary and secondary prevention.

Table 2. Requirements for acute stroke units

Minimum requirements for centres dealing with acute stroke patients
1 Availability of 24 h CT scanning
2 Established stroke treatment guidelines and operational procedures
3 Close co-operation of neurologists, internists, neuroradiologists and neurosurgeons in the evaluation and treatment
4 Specially trained nursing personnel
5 Early rehabilitation including speech therapy, occupational therapy and physical therapy
6 Established network of rehabilitations facilities
7 Neurosonological investigations within 24 h (extracranial and intracranial vessels, colour-coded duplex sonography, transcranial Doppler sonography)
8 ECG, Echocardiography, within 24 h
9 Laboratory examinations (including coagulation parameters)
10 Monitoring of blood pressure, blood gases, blood glucose, body temperature
Additional facilities recommended in acute neurological stroke units
1 MRI/MRA
2 Diffusion and perfusion MR
3 CT angiography
4 Echocardiography (transoesophageal)
5 Cerebral angiography
6 Transcranial Doppler sonography

For optimal acute stroke care, it is essential that all stroke patients are referred urgently to the hospital best equipped to provide the most appropriate acute stroke care. This may not necessarily be the nearest hospital. Certain subgroups of patients may benefit from intensive care or stroke unit care if they are identified and treated rapidly. Triage may be necessary and is recommended by the Stroke Council of the AHA, the American College of Physicians, and the European Ad Hoc Consensus Group.

Management in the Emergency Room

The time window for treatment of patients with acute brain infarction is considered to be 6–8 h, sometimes much less. In some patients, special circumstances may offer a longer treatment interval, but this is the exception, not the rule [Baron et al., 1995]. Accordingly, a new urgency for immediate treatment has developed during the past few years for which an emergency room (ER), critical care unit or stroke unit type setting may be appropriate for many acute stroke subtypes.

Acute management of acute stroke requires parallel processes at different levels of patient management. For example, acute *assessment* of neurological and vital functions parallels *treatment* of acutely life-threatening conditions. The selection of special treatment strategies may already be ongoing before the final decision on the subtype of acute stroke has been made. Time is the most important factor, especially the first minutes and hours after stroke.

The acute stroke patient, even the one with milder symptoms must be recognised as an urgently ill medical patient [Brott et al., 1994; Brott and Reed, 1989; Adams et al., 1994]. The patient has to be transported to an emergency unit, and the examining physician must assess the ischaemic stroke patient as having a *potentially* life-threatening or disabling illness. Of course, only a minority of the stroke patients present with a life-threatening condition, but most have some abnormalities in basic physiologic functions. One of the problems in the early treatment of acute stroke is to distinguish patients who need immediate life support and ICU treatment from those who can be managed in a stroke unit or normal ward. Symptoms which may predict later complications requiring secondary ICU treatment such a space-occupying infarction or bleeding, recurrent stroke, and medical conditions such as hypertensive crisis, co-existing myocardial infarction, aspiration pneumonia and renal failure must be recognised early. Early assessment of stroke subtypes based on the physical and neurological evaluation, and skilled use and interpretation of diagnostic tests is essential.

Initial Assessment in the Emergency Unit

The majority of stroke patients nowadays enter the hospital via the emergency or receiving unit. A different management strategy is necessary if the patient arrives in the hospital within the first few hours after stroke onset compared with patients who arrive later, for example 24 h after stroke. In the first case, the neurological examination has to be focussed on the severity of deficit, lesion localisation and possible sources of stroke. Simultaneously, conditions such as hypertensive crises, elevated blood glucose, aspiration, seizures or cardiac arrhythmias must be recognised and treated. Time is critical since the therapeutic window in a given patient may be quite narrow.

Written protocols for stroke are a prerequisite for standardised patient care. Pre-printed checklists can be used to ensure that the protocols are implemented. They should be produced for each stage in the management. These checklists should be formulated by the specialist coordinating stroke care in consultation with other staff, and can be personalised for each patient. The limits for intervention in physiological parameters, e.g. blood glucose levels or blood pressure, should be set on an individual patient basis. The use of protocols has been shown to significantly reduce the length of hospital stay and cost per patient and the incidence of complications [Odderson and McKenna, 1993].

Factors delaying early intervention within the hospital include (1) admission policies that require placement of patients in general medical wards, (2) lack of access to early brain-imaging facilities, (3) rating of stroke as non-urgent by hospital staff, (4) lack of treatment facilities for stroke and (5) unavailability of a neurologist or another physician with special expertise in stroke in the emergency room [Jørgensen et al., 1996; Wester et al., 1999].

The initial examination includes observation of breathing function, assessment of blood pressure and heart rate, and determination of arterial O_2 saturation using infrared pulse-oxymetry if available. Simultaneously, blood samples for clinical chemistry, coagulation and haematology studies are drawn, and a venous line is inserted. Standard electrolyte solutions are given until clinical chemistry results are available. After the emergency assessment, which in part will be done by emergency nurses or other ER personnel, the neurologist should perform a targeted neurological examination. The examination is supplemented, if possible, by a careful medical history focussing on arterio-sclerotic risk factors and cardiac disease. Especially in young patients, a history of drug abuse, oral contraceptive use, infection, trauma or migraine may give important clues.

The initial goal is to distinguish a cerebral infarction from intracerebral or subarachnoid haemorrhage using CT imaging. Immediate imaging (CT or MR) is particularly urgent in the patient with a decreased level of consciousness to establish the diagnosis. Although there are exceptions, the clinical hallmarks of intracerebral haemorrhage are headache, hemiplegia and depressed level of consciousness. A good rule of thumb is that any acute stroke with depressed level of consciousness or headache is haemorrhagic until proven otherwise. However, brainstem strokes and proximal distal initial carotid or embolic MCA infarction may present with a clinical syndrome not distinguishable from intracerebral haemorrhage.

Initial Emergent Treatment

Airways, Breathing and Pulmonary Function. Securing adequate oxygenation is an important part of general emergency procedures. In stroke patients, hypoxia may be

caused by pre-existing pulmonary conditions, changes in the ventilatory drive or aspiration. Securing airways is of special importance with patients with reduced consciousness [Horner et al., 1988]. In acute ischemic stroke, early changes in ventilatory drive and early respiratory disturbances due to reduced consciousness are rare. However, patients with complete and MCA ischaemia, large supra- or intratentorial haemorrhage or brainstem stroke may develop early ventilatory problems. In those cases, an endotracheal tube should be considered [Grotta et al., 1995]. Therefore, it maybe helpful that patients with severe stroke are continuously monitored with pulse oxymetry. They should be treated with supplemental oxygen, usually 2–4 litres per minute via nasal tubes for the acute period until the patient is stable, the diagnostic procedure is completed, and the patient has been brought to the ward [Hacke et al., 1995].

Concomitant Heart Disease. Cardiac abnormalities are frequently found with deep MCA infarcts, especially those involving the insular cortex. Nonetheless, the physician must carefully exclude acute MI, and look for atrial fibrillation or valvular disease. Each of these disorders may predispose to stroke and may jeoparadise cardiac function. Concomitant stroke and MI are a specifically serious problem and carry a bad prognosis [Furlan, 1987]. A significant percentage of elderly stroke patients may have low cardiac output at the time of stroke onset. The cardiac examination of the stroke patient includes assessment of the presence of tachypnoea, tachycardia, jugular venous distension, peripheral oedema or a third heart sound.

Antihypertensive Treatment in the ER. Acute stroke, either ischaemic or haemorrhagic, leads to a hypertensive reaction in the first hours and days after stroke. Most investigators nowadays agree that hypertension should not be treated drastically in the first hours after stroke. However, there are no data to recommend thresholds or time points of intervention and which drugs to use for hypertension control. Antihypertensive drugs should be used only in rare exceptions in the early hours following acute ischaemic stroke [Brott and Reed, 1989], i.e. for hypertensive crisis or heart failure. Frequently, it is suggested that in the early hours after stroke, arterial hypertension should only be treated if the systolic blood pressure exceeds 220 mm Hg on repeated measures, or if the diastolic pressure exceeds 120 mm Hg [Adams et al., 1994]. Drugs recommended for the treatment of such elevated hypertension vary from country to country. In essence, short-acting parenteral drugs that may be titrated over a venous line can be controlled best [Hacke et al., 1995]. Oral nifedipin is strongly discouraged.

In some stroke patients hypotension exists. This is of special risk in the setting of haemodynamic stenosis of intra- or extracranial vessels. Frequently, volume depletion is the cause of hypotension. Correction of hypovolaemia using hyperoncotic fluids and, in a few patients, also pressure drugs may be the treatment of choice.

Optimising Fluid and Electrolyte Balance. The main goal of fluid management in the acute phase is to establish and to maintain normovolaemia. Fluid depletion is best treated with isotonic saline or Ringers solution. Glucose-containing infusions are best avoided if there is no hypoglycaemia. Proper fluid management is the basis for an optimal cardiac output, which is desirable in the basic treatment of acute stroke [Adams et al., 1994; Hacke et al., 1995; The European Ad Hoc Consensus Group, 1997].

Blood Glucose and Fever. Experimentally, hyperglycaemia increases infarct size [Pulsinelli et al., 1983]. There are reports that a high glucose level at admission is linked to poorer neurological outcome after stroke [Jørgensen et al., 1994]. No controlled data are available concerning blood glucose control after acute stroke. Nevertheless, since hyperglycaemia maybe part of the stress response after stroke, it seems to be advisable to include treatment hyperglycaemia into the general treatment recommendations after stroke. Thresholds for intervention have not been prospectively established. In some centres, a cut-off value of >10 mmol/l blood glucose has been proposed. Elevated blood glucose should be counteracted using small doses of intravenous insulin. Since hypoglycaemia (<2.2 mmol/l) can also exacerbate neurological focal deficits, blood glucose levels must be measured in any patient presenting with symptoms and signs of acute stroke. Normalisation of the blood glucose level using 20 g of oral glucose or 10% glucose infusion by peripheral vein or 20% glucose via central venous line may reverse neurological dysfunction due to hypoglycaemia [Adams et al., 1994; The European Ad Hoc Consensus Group, 1996]. Except for the treatment of hypoglycaemia, no glucose-containing infusions should be used in the early or unstable stroke patient.

Fever also negatively influences outcome after stroke [Reith et al., 1996; Castillo et al., 1998]. Lowering of elevated body temperature is strongly suggested.

Recommendations

1 Secure airways and give oxygen to patients with severe acute stroke (level III).
2 Do not treat hypertension in patients with ischaemic stroke if they do not have critically elevated blood pressure levels (level III).
3 Treat fever and lower elevated blood glucose (level III).

Table 3. Emergent diagnostic tests in acute stroke

1	CT
2	ECG and chest X-ray
3	Clinical chemistry
	Complete blood count and platelet count, prothrombin time, INR, PTT
	Serum electrolytes
	Blood glucose
	CRP, sedimentation rate
	Arterial blood gas analysis, if hypoxia is suspected
	Hepatic and renal chemical analyses
4	Pulse oxymetry
5	Lumbar puncture (negative CT and suspicion of subarachnoidal haemorrhage only)
6	Duplex and transcranial ultrasound
7	EEG if seizures are suspected
8	MRI and MRA in selected cases; CTA
9	Diffusion MR and perfusion MR in selected cases
10	Echocardiography (transthoracic and transoesophageal) in selected cases

Emergent Diagnostic Tests

Diagnostic tests are needed to differentiate the types of acute stroke, e.g. ischaemic, brain haemorrhage, subarachnoid haemorrhage, to rule out other brain diseases, to get an impression about the underlying cause of brain ischaemia, to provide a basis for physiological monitoring of the stroke patient, and to identify concurrent diseases or evolving complications of stroke that may influence prognosis. Table 3 summarises the tests that may be useful for early evaluation of patients with acute stroke.

Cranial CT reliably distinguishes between haemorrhagic and ischaemic stroke. CT signs of early ischaemia can be detected as early as 2 h after stroke onset, but they may develop over time. Brain haemorrhages are identified almost immediately, but they may grow in the first hours, and therefore, a second CT scan may become necessary. CT also helps to identify other neurological diseases that may be confused with stroke. In addition, CT may detect subarachnoid blood in the majority of cases with SAH. Only very subtle SAHs, or older ones that occurred a week or two ago may be missed by CT. In those instances, examination of the spinal fluid should be performed. This is the only remaining indication for a lumbar puncture in the evaluation of acute stroke.

Very extensive early infarct signs in the first hours after stroke indicate a very serious ischaemia with a higher risk of secondary haemorrhage or of large oedema formation. While CT usually detects large infratentorial haemorrhages or cerebellar infarcts, smaller infarcts in the brainstem may be missed. In those cases, MRI is more sensitive; also, it has not yet reached the level of a standard procedure in most centres.

An electrocardiogram (ECG) should be performed in all stroke patients because of the high incidence of heart conditions in stroke patients. Stroke and acute myocardial infarction may occur together, hemispheric stroke may cause arrhythmias and heart failure. Frequently, atrial fibrillation is the course of embolic stroke.

Ultrasound studies are frequently performed in stroke centres throughout Europe. They include not only cw Doppler or duplex Doppler of the extracranial cervical arteries, but also transcranial Doppler. They are used to identify vessel occlusion, state of collaterals or re-canalisation. Other ultrasound studies include transthoracic and transoesophageal echocardiography to screen for cardiogenic emboli, but these studies are usually not performed in the ER. However, it seems to be useful to have these studies available in the first 24 h after stroke onset.

The role of modern MRI techniques such MRA, diffusion and perfusion MR has been demonstrated in small case series and in some smaller prospective trials. However, these techniques require major resources that are currently not available in a majority of centres.

Recommendations

1 A cranial CT is the most important diagnostic tool in patients with suspected stroke.
2 Early evaluation of physiological parameters, blood chemistry and haematology, and cardiac function is recommended in the management of acute stroke patients. This also includes ECG, pulsoximetry and chest X-ray.
3 Ultrasound of the extra- and intracranial vessels, modern MR techniques, cardiac ultrasound and special haematological and serological studies for rare causes of stroke should be performed early after stroke, but should not delay general or specific treatment.

Stroke Units

Stroke care should take place in a stroke unit. A meta-analysis based on the Stroke Unit Trialist's Collaboration showed an 18% reduction in mortality, a 29% reduction in death or activities of daily living (ADL) dependence and a 25% reduction in death or need of institutional care for patients treated in a stroke unit in comparison to a general medical ward. In a large randomized Norwegian trial of patients treated in the acute and subacute state [Rønnig and Guldvog, 1998] mortality was reduced by 46% compared to general ward treatment. The Copenha-

gen Stroke Study compared the results of stroke treatment in two neighbouring communities [Jørgensen et al., 1995]. In one, stroke treatment was performed in a stroke unit, and in the other, stroke unit treatment was not available. Mortality (odds ratio 0.5) and need of nursing home was lower in patients treated in the stroke unit (odds ratio 0.61). Length of hospital stay was reduced by 30% in the stroke unit. Also 5-year mortality [Strand et al., 1985; Indredavik et al., 1997; Jørgensen et al., 1999] is reduced for patients treated in stroke units.

A stroke unit is a hospital unit or part of a hospital unit that exclusively or nearly exclusively takes care of stroke patients. The staff and the multidisciplinary approach to treatment and care characterise the stroke unit. The core disciplines of such a multidisciplinary team are medical, nursing, physiotherapy, occupational therapy, speech and language therapy, and social work. The optimal size of a stroke unit in terms of beds is not known. Stroke units with as little as 6 beds have shown effectiveness.

Neurological outcome after stroke unit care is independent of age [Nakayama et al., 1994]. One third of the patients admitted to a stroke unit with the severest types of strokes will be discharged to a functionally independent life in their own home. Results from the Stroke Unit Trialist's Collaboration [1997] indicate that all types of strokes benefit from treatment and rehabilitation in stroke units: males and females, young and elderly stroke patients, and patients with mild, moderate and severe strokes. Hence, stroke unit care should be offered to a wide range of patients, and there is in particular no evidence to support exclusion of patients, either on the basis of age or on stroke severity. On the contrary, elderly and severer patients benefit most from stroke units [Strand et al., 1986].

Stroke units are available in several categories: (1) The acute stroke unit, admitting patients acutely and continuing for treatment several days, but usually less than 1 week; (2) the combined acute and rehabilitation stroke unit, admitting patients acutely and continuing treatment and rehabilitation for several weeks or months, if necessary; (3) the rehabilitation stroke unit, admitting patients after a delay of 1 or 2 weeks, and continuing treatment and rehabilitation for several weeks or months, if necessary; (4) a mobile stroke team offers stroke care and treatment to stroke patients at a variety of wards. Such teams are usually established in hospitals where stroke units are not available. Of these, only the combined acute and rehabilitation stroke unit, and the rehabilitation stroke unit have proven effectiveness in terms of reduced mortality and handicap. Proof of effectiveness is lacking for the acute stroke units without rehabilitations as well as for the mobile stroke team.

The reasons why patients in stroke units do much better than patients with conventional care is not known. Patients treated in stroke units do not receive more physico- or occupational therapy than stroke patients treated in normal wards [Indredavik et al., 1999; Kalra et al., 1993]. However, infections are less common in stroke units, and the personnel seems more aware of swallowing problems [Kalra et al., 1995], raised temperature and fluctuations in blood pressure. The most prominent feature of a stroke unit compared to a conventional ward is, however, systematic prevention of complications, shorter time to start of mobilisation and early rehabilitation [Indredavik et al., 1997]. These are probably the main reasons for the proven reduction of mortality of patients treated in stroke units. Access to multidisciplinary rehabilitation including oriented nursing care very early on is thus a very important feature of an effective stroke unit. The effects of the characteristic features of a stroke unit, such as a specially trained staff, teamwork, continuous education and involvement of relatives, are as yet not tested, but might be of significant importance. Effectiveness of a stroke unit is not necessarily related to a certain medical speciality. Stroke units run by internists, geriatricians, neurologists or specialists in rehabilitation medicine may be equally effective [Stroke Unit Trialist's Collaboration, 1997]; however, when tested, care in neurology wards has proven superior [Kaste et al., 1995].

In Europe, stroke is increasingly considered as an acute medical emergency with the need for immediate hospitalisation [Aboderin and Venables, 1996]. This recommendation has been based on the assumption that the patients would benefit from immediate diagnostic work-up, monitoring, supportive treatment and prevention of medical complications. Justification of stroke as a medical emergency has been well documented, based on the results of stroke unit treatment including immediate hospitalisation in the management concept. Moreover, the earlier the mobilisation and rehabilitation the better the outcome.

In unselected Scandinavian series [Jørgensen et al., 1996; Weste et al., 1999], about 30% of the stroke patients arrived within 3 h, 40–50% within 6 h and 50–60% within 12 h of the stroke. Patients contacting ambulance transportation via 112 arrived much earlier than patients contacting a GP. Patients with a well-working network likewise arrived much earlier compared with patients without such a network. Hence, patients living with a spouse arrived earlier at the hospital than patients who lived

Table 4. A few guidelines on how to estimate the outcome of a stroke patient

1	If the level of consciousness is reduced together with hemiplegia, the mortality is about 40%, and immediate prognosis is poor until actual improvement begins.
2	Rapid onset (less than 5 min) of maximal neurological deficit persisting for 72–96 h generally means that normal function will not return.
3	If there is any movement in the leg during the first week, the probability that the patient will be able to walk independently is 80%.
4	If there is no meaningful distal motor function in the hand during the first week, the likelihood that the hand will recover performance of higher-skilled activities is 20%.

alone. Patients with severe strokes, including haemorrhagic strokes, arrived earlier than patients with milder strokes. Knowledge about stroke symptoms seems also of importance, as stroke patients having experienced a TIA arrive earlier to hospital.

Rehabilitation of Stroke Patients

The annual incidence of stroke in Europe, including first and recurrent stroke, varies from 150 to 280 per 100,000. This variation is for the most part due to differences in the age structure and the risk factor profiles of the populations involved. The incidence rates rise sharply with advancing age. One third of the stroke patients are younger, two thirds older than 65 years of age [Kaste et al., 1998]. The degree of disability in this large group of patients varies from catastrophic outcome with total dependence to minimal and manageable disability and to no deficit at all. At least half of the stroke patients have significant neurological residua that limit independence, and one fifth will remain totally dependent. Rehabilitation can reduce the number of patients who are left dependent after stroke. The physician is almost always asked early on about the prediction of outcome of a specific patient. Table 4 shows items which may help in estimating outcome.

Early Rehabilitation

Forty percent of stroke patients need active rehabilitation services. Rehabilitation of a stroke victim is started as soon as possible. This means that the patient should immediately be brought to a hospital with such facilites, not only for acute diagnosis and therapy, but also for early rehabilitation. The intensity of the actual rehabilitation program depends on the status of the patient and the degree of the disability. If the patient is unconscious, the rehabilitation is passive to prevent contractions and joint pain, and to prevent distress for the patient when movement is restarted after immobilisation. With passive rehabilitation, one can also minimise the risk of bedsores and pneumonia. All joints on the paralysed side are moved through the full range of motion several times a day (3–4 times at least). When the patient recovers consciousness and is able to co-operate, or if the patient has a normal level of consciousness already from the onset of symptoms, then the patient is encouraged to take an active part in the rehabilitation programme. Patients rarely need to be immobilised in bed for more than 1 or 2 days after the sroke unless they have a major decrease in the level of consciousness. Prolonged immobilisation and hemiplegia carry the risk of deep venous thrombosis and the complication of pulmonary embolism. In hemiplegic patients and those stroke patients who must be immobile for more than a day or two, low-dose heparin or low-molecular-weight heparin therapy should be given subcutaneously. After 2 or 3 days, most patients who are alert can be moved out of bed with safety and placed in either a wheel chair or fixed chair for a good part of each day.

Rehabilitation Programme

Once the initial phase of stroke has passed, the patients should be carefully assessed for the degree of disability, and a detailed rehabilitation programme for him/her should be made. The assessment of the patient's situation includes evaluation of intellectual impairment, including specific cognitive deficits such as aphasia, agnosia, apraxia, mood, motivation, the degree of motor weakness, sensory loss and visual loss. Other problems that influence the patients' ability to respond to rehabilitation include financial burden, chances of return to social activities and work, to live at home, sexual function and the need for care [Gresham, 1992].

The multi-disciplinary stroke team required to provide adequate rehabilitation for stroke victims includes (1) the patient's physician, who is interested in and trained for stroke; (2) the patient's nurse experienced in stroke management; (3) a physiotherapist trained in stroke rehabilitation; (4) an occupational therapist skilled in stroke; (5) a speech therapist familiar with speech problems in stroke; (6) a neuropsychologist accustomed to stroke rehabilitation, and (7) a social worker familiar with the problems of stroke patients [Adams et al., 1994].

Of course, most hospitals treating stroke patients do not have all these specially trained stroke experts. The core of the stroke team, physician, nurse, physiotherapist and speech therapist can be found in most hospitals, and they can provide a decent rehabilitation programme if they take it as a challenge.

Not all stroke patients have identical potential for recovery. The factors listed in table 5 are prognostic for less optimal outcome after rehabilitation. The more of the above-mentioned predictors for poor outcome the patient has, the less optimal candidate he/she is for rehabilitation. If there is a local shortage of money and/or rehabilitation services, the resources should be allocated to those patients who are most likely to be able to take advantage of the resources invested. The elderly and severer stroke patients are those who benefit most [Strand et al., 1986]. The aspects of neurological dysfunction that are used to predict outcome are valid for large groups of patients. For individual patients, the variation in outcome may be great. In view of this, it is generally recommended that a trial of the rehabilitation programme should be carried out to assess a patient's potential for becoming independent. This is particularly rewarding when a patient who is believed to have no rehabilitation potential responds to treatment and becomes independent or less dependent.

After the assessment of a stroke patient by the members of the stroke rehabilitation team, a customised rehabilitation programme will be tailored. The progress of the patient needs to be followed on a daily basis by the different members involved. Once a week, the members of the stroke team should meet and analyse the progress of individual stroke patients. Should there be a blocking in any of the aspects of the rehabilitation programme, the reason for it, for example untreated depression, needs to be found out and corrected if possible. The individual patients and the members of their family should be members of the stroke team. They should be taught the principles of stroke rehabilitation, and the members of the family also need to be taught when not to help the patient in order to optimise the progress of the rehabilitation plan. As soon as the patient's condition allows, he/she should visit his/her own home, to smooth the transit from hospital to home and increase the patient's motivation to try their best in rehabilitation. The occupational therapist or a physiotherapist should undertake the home visit together with the patient to evaluate the changes needed at home in order to support the patient's discharge from hospital [Kaste et al., 1995].

Table 5. Factors indicating poor outcome

Poor outcome
Reduced level of consciousness for longer periods
Incontinence for more than 2 weeks
Dementia
Marked receptive dysphasia
Severe hemiparesis/hemiplegia with no recovery of motor function within a month
Serious pre-existent systemic disease, especially heart disease
Neglect with no recovery
Probably poor outcome
Hemisensory defect
Right hemispheric injury
Marked pre-existent loss of cognitive ability
Marked depression
High age
Previous stroke
Poor socio-economic background
Absence of a family or inability of existing family to help

As soon as it is obvious that the patient needs a longer rehabilitation period than can be provided within the acute hospital, they should be transferred to a special rehabilitation hospital if such a place is available. When the patient is transferred to a rehabilitation hospital, it is of the utmost importance that all members of the stroke team transfer documentation of the patient's progress to the stroke team of the rehabilitation hospital [Kaste et al., 1995]. After institutional rehabilitation, the rehabilitation programme can be taken over by the out-patient rehabilitation clinic, if one exists locally. This ensures the smooth transfer of the patient to the next rehabilitation step and the road back to normal life. The length of the rehabilitation period in the acute stage depends upon the severity of the stroke and locally available stroke rehabilitation services. The acute stage of the rehabilitation programme should not last longer than is actually needed for a good outcome. This is usually 6–12 weeks and rarely more than 24 weeks.

Late Rehabilitation

The fastest recovery of neurological deficit occurs during the first 3 months after the onset of symptoms. This is also the optimal time for rehabilitation. Active rehabilitation, however, should be administrated as long as objective improvement in the neurological dysfunction is observed.

After most of the improvement in neurological dysfunction has occurred, and the active rehabilitation pro-

gramme has come to an end, the stroke patient needs a long-term rehabilitation programme. This is to guarantee that the functional status which has been achieved during the acute rehabilitation programme is sustained. Should the functional outcome of a patient be in jeopardy, an active more comprehensive rehabilitation programme is needed, and sometimes it is reasonable to re-admit the patient for a more intensive in-patient rehabilitation period.

Assessment of the Quality of Rehabilitation

The results of the rehabilitation programme for patients with stroke are usually measured by whether the patient can return home and by the degree of independence achieved in ADL. The quality of life is less seldom assessed, and there is no generally accepted scale to evaluate the quality of life of stroke patients [Kaste et al., 1998].

Activities of Daily Living. The most often used instrument to measure the ADL of a stroke patient is the Barthel Index. Although it is far from optimal, it is one with which everyone is familiar, which is an important advantage and makes it suitable for comparisons not only between individual patients but also between institutions and countries.

Handicap. The clinical impression of a patient's handicap can be evaluated by using the Rankin Scale. It is a 5-grade scale, which gives an overall impression of the life situation of a patient. It is quite often used in evaluating the recovery of stroke patients and gives once again an instrument to compare different strategies in stroke management.

Mood. Depression after stroke is common. With the Hamilton Rating Scale for Depression [Hamilton, 1960] or the Beck Depression Inventory [Beck et al., 1961], the mood of a patient can be assessed, but they include some items which are not useful for patients with stroke. Furthermore, they are not suitable for reliable assessment of stroke patients with major speech problems. If depression is present, it should be treated. The treatment of depression not only affects the quality of life of the patients, treated patients show more improvement in rehabilitation programmes than do those who are not treated for depression.

Is There Evidence that Rehabilitation Programmes Are Indicated?

Rehabilitation programmes do not change the neurological deficit, but patients can become ambulatory and largely independent. Of more importance is the fact that the majority of patients are able to be at home and do not require nursing-home care.

A controlled randomised study from Helsinki compared patients who were treated and rehabilitated systematically by a stroke team with patients included in a less systematic stroke management proramme trial [Kaste et al., 1995]. Elderly stroke patients treated by a stroke team were able to leave the hospital on an average 16 days earlier (24 vs. 40 days), went directly home more often (75 vs. 62%) and were more often fully independent in ADL (76 vs. 59%) 1 year after the onset of stroke. A better outcome of stroke is of benefit in both human and economic terms. That such results can be achieved with systematic stroke management and not by chance is verified by identical results from the University Hospitals of Umeå, Sweden [Strand et al., 1985], Kuopio, Finland [Sivenius, 1985] and Trondheim, Norway [Indredavik et al., 1991].

Recommendations

1 Every patient should have access to evaluation for rehabilitation (level III).
2 Rehabilitation should be initiated early after stroke (level I).
3 Rehabilitation services should be provided by a multidisciplinary team (level III).

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