Neurological acute stroke care: the role of European neurology

European Federation of Neurological Societies Task Force

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In 1995 the EFNS has made stroke treatment and prevention a major policy issue and established a Task Force to develop guidelines for acute neurological stroke care for use by neurologists throughout Europe and to be modified according to local and national requirements. This Task Force report supplements recommendations and treatment guidelines previously published. It focuses on the need of adapting neurological hospital services to immediate stroke care and sets up lines of argumentation and organisational recommendations compiled on various levels of evidence. Due to the increase of aging populations across Europe the socioeconomic and health burden of stroke will increase in many countries within the next decades. In addition, acute stroke mortality differs greatly among European countries being the highest in many countries of Eastern Europe and lowest in many of the Western nations. This implies that management of acute stroke varies in intensity and quality and a uniform improvement of care can be achieved in many countries by involving more neurologists. The viability of ischemic brain tissue may extend up to 18 or even 24 hours but experimental and human stroke research shows that the earlier the intervention takes place the more likely the outcome is favourable. Thrombolysis has been recommended for use within a therapeutic time window of up to 3 hours following the onset of stroke, a time window of up to 6 hours is currently being tested. Neuroprotection drugs are being tested for time windows up to 12 hours. Factors delaying early hospital referral as well as factors delaying in-hospital management can be overcome if neurologists participate in public education programmes that propagate early recognition of symptoms and advocate emergency hospitalization. Training Programmes for medical and paramedical staff can improve initial diagnosis of stroke. Organizational structures within the hospital are recommended that allow neurologists to react quickly and have access to all investigations on an emergency basis. It is important to have an early accurate diagnosis of the stroke as various subtypes have different frequencies with which complications and associated comorbidities occur, have varying rates and patterns of worsening and recurrence. It is essential to establish neurological stroke units for acute care wherever possible. Such units have been shown to be effective but their elements and components making them most efficacious are still not well known. Neurological acute stroke units have the primary aim of initiating stroke treatment on an emergency basis and of clarifying the stroke cause. Ready availability of CT, neurosonological investigations, ECG, echocardiography, and laboratory tests including coagulation is mandatory. Cardiac monitoring as well as monitoring of blood pressure, blood gases, body temperature and blood glucose should be performed immediately upon hospital arrival. When available, arteriography, MRI, EEG monitoring, and new brain imaging techniques should be used. An acute stroke unit should consist of 6 (4-8) beds. Depending on the severity of stroke, case-mix and complication rates such a unit can serve a population between 200,000 and 400,000 inhabitants and treat 350 to 800 strokes per year. After stabilisation, referral to a non-intensive stroke rehabilitation unit is recommended. In larger hospitals where a stroke unit cannot be installed easily it is recommended to set up a mobile neurological acute stroke team that is available at emergency departments. Neurologists should be able to take up the history of the patient from the paramedics immediately upon arrival, make the first assessment and follow the patient to other departments. Seamless management includes early neurorehabilitation, the use of a stroke pathway and access to all investigations in order to perform therapies on an emergency basis.

INTRODUCTION: THE INCREASING BURDEN OF STROKE

In Europe stroke is a leading cause of death and the most common cause of severe disability in adults. In most Western European countries, death from stroke has declined by 30–50% since 1975, but in the countries of Eastern Europe stroke mortality has remained stable or slightly increased over the same period of time (Asplund, 1996; Khaw, 1996; Stegmayr et al., 1996). Despite the decline in mortality in Western Europe, the incidence of stroke is expected to increase within the next few decades, mainly due to a 30% growth in the elderly population, which will
lead to an increase in the health burden of stroke with consequent increases in economic costs. Lifetime costs of first-ever stroke are estimated at between US$40,000 in the Netherlands and US$80,000 in Sweden, of which hospital costs account for 45% in the first year after a stroke (Asplund et al., 1993; Bergman et al., 1995); it is estimated that hospital costs will increase by 1.5% per year (Bergman et al., 1995). Across Europe, therefore, with its ageing population, there is a pressing need to cope with this increase, and make stroke prevention and treatment a priority to reduce the growing health burden and lessen its socio-economic impact.

Improving acute stroke care along established and evidence-based principles is a substantial undertaking. The World Health Organization (WHO) Monitoring in Cardiovascular Disease (MONICA) project (Thorvaldse et al., 1995) has demonstrated a large variation between countries in case fatality rates (the proportion of fatalities occurring within 28 days after onset of acute stroke), ranging from 15% in northern countries to 50% in some Eastern European states. The implications of these findings are that the quality of acute stroke care varies between countries and that an improvement in initial diagnosis, treatment and rehabilitation programmes will reduce case fatality rates.

**EFNS TASK FORCE ON STROKE AND EXISTING GUIDELINES**

National neurological societies have become increasingly aware of the need to address the problem of acute stroke care through consensus statements and training programmes. In particular, there is a need to set up specialized treatment facilities for the acute care of patients with stroke. In 1995 the European Federation of Neurological Societies (EFNS) made stroke treatment and prevention a major policy issue. A Task Force on Neurological Acute Stroke Care was instructed to develop guidelines for the implementation of stroke management policies for use by neurologists in all European countries with the intention that these guidelines could then be modified according to local and national requirements.

Other guidelines have focused on general issues of stroke care, public awareness and education programmes and treatment, rehabilitation and organizational issues. An *ad hoc* consensus group (European *Ad Hoc Consensus Group*, 1996, 1997) has compiled all available evidence about early intervention in acute stroke and laid down the principles of intensive care. A report from the American Heart Association has developed guidelines for the management of patients with acute ischaemic stroke (Adams et al., 1994). This has been supplemented by a practice advisory document on thrombolytic therapy for acute ischaemic stroke by the American Academy of Neurology (American Academy of Neurology, 1996). The WHO/European Stroke Council “Helsingborg Declaration” (World Health Organization/European Stroke Council, 1996) addressed the need to develop specific acute care and rehabilitation facilities in an organized fashion in order to reduce mortality and disability. The present guidelines are intended to focus on the role of neurological services and neurologists in the acute care of people with stroke, and supplement already existing reports and guidelines.

**NEUROLOGISTS MUST COPE WITH STROKE EMERGENCIES ON A DAILY BASIS**

Neurologists have played a major part in experimental and clinical research into therapy of cerebrovascular diseases. Harrison *et al.* (1971) first suggested that aspirin might reduce the frequency of transient ischaemic attacks. These observations opened the way for the first of many large randomized trials of aspirin in both secondary prevention (Canadian Cooperative Study Group, 1978) and, more recently, acute intervention trials in ischaemic stroke (International Stroke Trial Collaborative Group, 1997; Chinese Acute Stroke Trail Collaborative Group, 1997).

Data from both animal and human stroke research suggest that the earlier intervention takes place the more likely it is that the outcome will be favourable. Cerebral tissue may remain viable for up to 18–24 h after acute ischaemia, even if cerebral blood flow is below 22 ml/100 g per min, provided there is a high level of oxygen extraction and a high cerebral metabolic rate for oxygen (Baron *et al.*, 1995). Thrombolysis is now recommended in North America if undertaken within 3 h of the onset of stroke, and further clinical trials testing the efficacy of thrombolysis are under way with a time window of up to 6 h. Neuroradiontional trials presently test a therapeutic time window up to 12 h.

Therefore, neurologists involved in the acute care of stroke must now operate within organizational structures that allow them to react quickly, as therapeutic measures undertaken outside the appropriate time windows are less likely to be effective and may be harmful. The fact that neurologists must now cope with stroke emergencies on a daily basis represents a major turning point in clinical neurology.

**TREATMENT DELAYS BOTH OUTSIDE AND INSIDE THE HOSPITAL CAN BE AVOIDED**

Various factors are responsible for delay in patient referral to hospital. These include a poor awareness of the stroke by the victim or family, reluctance to seek emergency or medical help, incorrect diagnosis by the paramedical service and rating stroke as a non-emergency by medical personnel and the family physician. In Germany, only 5% of
the population are aware of the warning signs of stroke compared with 50% who know about myocardial ischaemia (A. Kottmaier, unpublished data). Jørgenson et al. (1996) showed that patients who had previously suffered a transient ischaemic attack underwent shorter admission times when they experienced a stroke in comparison to patients with first-ever strokes not known to have had a transient ischaemic attack. Ambulance staff are known to make an incorrect diagnosis in 50% of patients compared with 25% by paramedics (Kothari et al., 1995).

Because of these factors, traditional settings for the treatment of patients with acute stroke may not be appropriate. Neurologists should be involved in the public education and training of paramedical staff, stress the importance of awareness about stroke, the early recognition of symptoms and the need for emergency hospitalization.

Within the hospital, factors delaying early intervention include admission policies that require placement of patients on general medical wards, lack of access to early brain-imaging facilities, the rating of stroke as non-urgent by hospital staff, non-existent treatment facilities for stroke at the point of admission and unavailability of a neurologist in the emergency room. This may lead to delays in the early recognition of stroke, prolonged ‘door to drug’ times, failure to use new treatment modalities, including thrombolysis, and the introduction of early secondary prevention measure. Conditions other than stroke that present stroke-like syndromes, such as hypoglycaemia or subdural haematoma, may be life-threatening, and non ischaemic stroke may account for up to 25% of acute stroke admissions (Bratina et al., 1995). Delay in imaging is common (Anderson et al., 1995); despite a median arrival time of 4.3 h for ischaemic stroke and 2 h for intracerebral or subarachnoid haemorrhage, computed tomography (CT) was delayed by a median of 66 h for the former compared with a few hours by the intervention of the emergency stroke team (Bratina et al., 1995).

EARLY ACCURATE DIAGNOSIS CAN BE ACHIEVED

Different stroke subtypes have different aetiologies, differing frequencies with which complications and associated comorbidities occur, differing rates of early recurrence and varying rates and patterns of deterioration and prognosis; therefore accurate diagnosis is required for appropriate management.

A history and physical examination may assist in the classification of the stroke subtype and allow priorities to be determined for additional investigations and treatments. Subtypes include stroke due to arterial atherothrombosis, cardiac embolism, small-vessel occlusion and cryptogenic and uncertain aetiologies. In a recent study, early categorization of the initial stroke type on clinical and CT criteria proved to be correct in 62% of patients compared with a final diagnosis 3 months later for all stroke types (Madden et al., 1995). Even then, 15% could not be categorized. In another study, lacunar stroke was correctly distinguished from non-lacunar stroke in 56% of cases within 12 h after onset in 517 patients presenting with first-ever stroke (Toni et al., 1995). The effect of this on prognosis was demonstrated by Libman et al. (1995) who showed that pure motor hemiparesis tended to improve rapidly over 10 days. These studies show that even for expert neurologists, the early diagnosis of stroke subtype is difficult on clinical grounds alone but may become more reliable when the results of further examinations, in addition to the initial CT, are readily available.

NEUROLOGICAL STROKE UNITS ARE NOW WIDELY ACCEPTED

The use of neurological stroke units within the first week has yet to be evaluated in formal trials. Most of the evidence for the effectiveness of organized stroke care has come from stroke rehabilitation.

Level I evidence

Randomized studies have shown that stroke units are effective in reducing mortality compared with treating patients on general medical ward. A meta-analysis of all trials of stroke units compared with care in a general medical setting showed a 21% reduction in mortality after 12 months (Langhorne et al., 1993). Individual trials include a prospective randomized study of acute stroke patients in which there was an improvement in functional outcome and a reduction in the need for long-term care in patients who randomly allocated to a non-intensive stroke unit compared with a general medical ward (Strand et al., 1985). In this study, 15% of those randomized to stroke unit care and 39% of those on a general ward remained hospitalized. Functional outcome was better, as measured by the Activities of Daily Living scale, including measurements in the domains of walking, personal hygiene and dressing. The precise mechanism for this remains unclear, though the authors suggest that teamwork and early onset of rehabilitation may be important. Kaste et al. (1995) showed that patients randomly allocated to care in the neurology department left hospital earlier, went home directly more often, and were more commonly independent after 1 year than those treated on medical wards. While the fatality rate was no different, the authors suggested that better organization of care played a part in the improved outcome.

Demographic variables are well matched in most studies, but data about the time of admission and the onset and intensity of rehabilitation measures are usually lacking in these studies, so that no general conclusions can be drawn about the efficacy of acute stroke units.
Level II evidence

Two studies have compared the efficacy of stroke rehabilitation units with historical controls treated on general medical wards. Jørgenson et al. (1995) studied 936 acute stroke patients managed in a stroke unit of 61 beds and compared them with 305 patients managed in general wards at another hospital. Both groups were similar in terms of age and time of admission to the unit. Case fatality rates, percentage discharged to a nursing home, length of stay for all patients and length of stay for those aged over 70 years were all lower among those treated in a stroke unit. The authors (Jørgenson et al., 1995) attributed their success to a standard evaluation programme, intensive observation and goal-oriented treatment in the first few days after admission.

Bath et al. (1996) provided some evidence that immediate admission to a stroke unit might be efficacious. Patients admitted immediately to an eight-bed stroke unit and transferred after an average of 7 days to postacute treatment facilities were compared with historical controls treated on a general medical or geriatric ward. The patients treated in a special unit showed a reduced time to admission from the emergency unit, earlier CT, more carotid sonography, a greater likelihood of being given aspirin on discharge and a reduced in-patient hospital stay. Bath et al. (1996) suggest that a better outcome might be related to an improved diagnosis, directed rehabilitation, fewer early complications and better early secondary prevention measures.

Level III evidence

In a survey in 18 Spanish hospitals, the time from the onset of a stroke or a transient ischaemic attack to contact with a neurologist was compared. Those admitted or evaluated early had an improved outcome as measured by an impairment scale and a reduced length of stay (Davalos et al., 1995). Intensive management of hypertension and hyperglycaemia in the acute phase was thought to have contributed to this. Some evidence from North America suggests that neurologists who treat stroke are more likely to be knowledgeable about the causes of stroke that others, and their patients have a better outcome than those treated by internists or general practitioners. Medicare evaluated 20% of their stroke patients treated in 1991 and found that patients treated by neurologists had a significantly lower 90-day mortality (Mitchell et al., 1996); however these patients were not matched for stroke severity or comorbid disease. The same data showed that neurologists used more imaging procedures, including CT, magnetic resonance imaging (MRI), angiography and more prothrombin tests for anticoagulant control. They also made more use of rehabilitation facilities and made less use of nursing facilities and nursing homes. However, the neurologists incurred high hospitalization costs compared with internists and general practitioners. This mirrors Medicare costs for myocardial infarction as cardiologists have gradually taken over the care of this group of patients.

There are no evidence-based guidelines in the following areas, though clinical trials are under way in some: the management of swallowing disorders and the prevention of aspiration using either a nasogastric tube or via percutaneous gastrostomy (Holst et al., 1994; Smithard et al., 1996), nutritional supplements after a stroke, the use of intracranial monitoring and other aspects of intensive care, including optimal control of hyperpyrexia (Grotta et al., 1995; El-Ad et al., 1996; Reith et al., 1996; Schwab et al., 1996; European Ad Hoc Consensus Group, 1997).

Ethical issues also need to be considered, and a rational approach to ‘do not resuscitate’ orders is required, especially to assist in the management of patients who are locked in or in vegetative states (Alecandrow et al., 1995, 1996).

Further unanswered questions about acute stroke care include questions about appropriate diagnostic techniques (Mohan et al., 1995; Schneider et al., 1996), pharmacotherapy for cerebral ischaemia (Marshall and Mohr, 1993) and effective means of preventing complications (Davenport et al., 1996).

None of the studies reported above give a detailed analysis of the elements of stroke care that might be essential in a neurological acute stroke unit and detailed descriptions of all the components remain to be undertaken.

RECOMMENDATIONS

Two models of care are proposed. One involves the use of dedicated facilities for acute neurological care within a hospital, the other a mobile neurological acute stroke team when dedicated facilities are not available.

The primary aim of either model is:
• accurate diagnosis to minimize complications and recurrence;
• initiation of acute stroke treatment.

Acute care starts with the patient as soon as symptoms are experienced. Patients require education about the significance of their symptoms, while paramedical staff and general practitioners need to know how to access the stroke team or stroke unit. All admissions trails should therefore be clearly visible and available to the community prehospital services. Within the hospital setting neurologists should have early access to patients with stroke and full access to appropriate investigational facilities.

Neurological acute stroke unit

It is important to have a stroke unit within a defined setting. These units mostly consist of a small number of beds which are exclusively and immediately available for all
admissions with stroke-like symptoms. Many neurological departments treating acute patients already have monitoring devices available for their patients as well as neurologists with a specialized interest and training to treat acute strokes. With an increasing tendency to apply early and very early interventions, especially thrombolysis, it is also evident that neurological acute stroke units will be the specialized setting for any kind of treatment which has to be performed within the first few hours after the onset of a stroke. Initial management on a general ward will not be easily justified for treatments that have a hazardous potential.

A concept for neurological acute stroke care should follow an integrated concept for treatment and include the prehospital emergency setting, rapid transfer to centers with a neurological stroke unit, emergency treatment following admission, initial neurological and neuroradiological assessment, additional investigations, secondary and tertiary prophylaxis, continuous neuromonitoring and therapy during the acute phase, and consecutive transfer, preferably to a non-intensive-care stroke rehabilitation unit (Fig. 1).

This acute stroke unit has the primary task of performing very early evaluation and management following the early days after a stroke. Other additional elements are optional and vary from country to country. In some countries or regions, stroke units have been established to include early rehabilitation as well. This is a compatible addition to an acute stroke unit. Stroke units that exclusively focus on rehabilitation in the postacute phase follow a different task and their efforts cannot easily be compared with a neurological acute stroke unit.

Acute stroke units have the primary aim of initiating stroke treatment on an emergency basis and of clarifying the causes of the stroke in order to prevent further relapses and complications. All other aspects are secondary. Prehospital structures must be adapted to this primary aim. Within the hospital their patients must have access to all investigations on an emergency basis. There should be a ready availability of CT, arteriography, echocardiography, Dopplersonography including transcranial Doppler sonography and transcranial Doppler monitoring, as well as CT angiography, MRI and MRA if situated within reach (Tables 1 and 2).

**Neurological acute stroke team**

Many hospitals do not yet have acute stroke units. These are often large general hospitals with a neurological department that consists of a small number of beds providing a ward consultation service. In this type of traditional setting, neurologists are recommended to install mobile stroke teams that are rapidly available on an emergency basis throughout the hospital (Fig. 2). These neurologists should have the primary competence for all acute strokes as soon as they are admitted. If there is an emergency room or emergency department for all hospital admissions, a neurologist should be easily and rapidly available for those admissions and have a chance to take a history from the paramedics and make a first assessment. They should follow the patients to intensive care, to coronary care, to general medical or geriatric wards. After initial management, neurologists should be able to start with neurorehabilitation as soon as possible. Physiotherapists, occupational therapists and speech therapists should therefore also be-
long to the mobile stroke team. After some time, a successful mobile stroke team is often able to install an acute stroke unit with beds and neurmonitoring equipment. In order to justify this, the work of this team should be carefully and separately documented from the beginning, to allow an evaluation of the clinical successes and the costs of the interventions. In addition, a checklist of interventions and investigations is helpful in recording the work on an individual patient. A written clinical pathway for acute strokes is even better than a mere checklist because it makes the process of clinical decision-making more transparent. Interdisciplinary cooperation with other medical specialists is essential for the general management of stroke.

Prehospital and acute in-hospital management
A neurological acute stroke unit must start outside the hospital: Emergency physicians, paramedics and referring doctors as well as the general population within the district should know that this acute stroke unit exists and is operational at all hours. A neurologist should be available 24 h a day on an emergency basis in order to attend all admissions with a stroke syndrome, to perform a rapid neurological investigation and to check vital and cardiovascular parameters. He will take a short patient history and decide on the location and cause of the infarct. Inevitably, a CT scan and a laboratory screening will be needed on an emergency basis as well as further investigations. Doppler investigations of the extra- and intracranial vessels, echocardiographic investigations of the heart and aortic arch and the option to perform cerebral angio-

GEOGRAPHICAL RECOMMENDATIONS
A neurological acute stroke unit should consist of four to eight beds (ideal size six beds) and aim at treating acute strokes for 2–7 days (average 4–5 days) depending on the severity, complications and case-mix. With a regional incidence of 200 first-ever strokes per 100,000 inhabitants per year and a hospitalization rate of 70–80%, one acute stroke unit may serve approximately 200,000–300,000 inhabitants. This implies that 350–500 strokes are treated per year, including recurrent strokes. If the average patient stay can be reduced to 2–4 days, a stroke unit can serve a larger population of approximately 300,000–400,000 inhabitants, thus treating up to 800 strokes per year.

ORGANIZATIONAL RECOMMENDATIONS
Diagnostic and therapeutic measures are standardized and are updated at regular intervals. Stroke protocols and present clinical pathways are important for a continuous assessment of the quality of performance of the stroke unit. The first assessment includes the decision on whether the patient has to be intubated and ventilated and therefore transferred to an intensive care unit. If no intensive care unit is easily available some stroke units might decide to start artificial or assisted ventilation before transferring the patient. The majority of patients, however, do not require ventilation and can be referred on after stabilization, preferably to a non-intensive-care stroke rehabilitation unit. Physiotherapy, occupational therapy and speech therapy can be started in order to guarantee seamless care.

REFERENCES

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