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Chapter 58

Acute stroke units and teams

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58.1. Introduction

Stroke represents a major cause of death, cognitive impairment, and disability. The type of care patients receive varies from country to country also depending on local habits, political issues and resources available. The sensitivity of the brain to brief episodes of profound ischemia or prolonged periods of modest ischemia requires an aggressive approach to acute stroke care. Often patients do not receive the appropriate care in time. In Germany as well as in the USA, patients are more likely to get acute stroke intensive care treatment during the first days, while in France, Switzerland, Norway, Sweden, and some other European countries, patients are more likely to be treated initially by means of different, individually modeled stroke service pathways. It is therefore crucial to first determine what aim should be targeted when managing stroke patients. The focus of this chapter lies on the treatment of patients with focal cerebral ischemia, which accounts for about 85% of most etiologies of strokes.

The common goals of the management of patients affected from possible symptoms of transient ischemic attacks or stroke are (Helsingborg Conference, 1995; Aboderin and Venables, 1996; Warlow et al., 2001):

1. prompt and accurate diagnosis of the stroke and the underlying etiology;
2. specific medical and surgical treatment;
3. assessment of patients' stroke-related medical problems in the acute phase and providing adequate care;
4. terminal care for patients that are unlikely to survive;
5. comprehensive rehabilitation;
6. continuing long-term care for severely disabled patients;
7. hospital discharge and placement;
8. adequate secondary prevention of further vascular events including surgery or interventional radiology, where appropriate;
9. educational and research program;
10. established guidelines.

58.2. Definitions

It is crucial to first outline the different existing types of stroke care which range from services providing acute stroke care during the first days after stroke to the service only providing rehabilitation. The various aspects may refer to the following items:

1. geographic location of stroke treatment, such as emergency ward, intensive care unit, specialized ward, general ward;
2. consistency of the diagnostic and treatment process;
3. expertise of the treating physicians and involved staff members;
4. availability of diagnostic facilities and general infrastructure;
5. focus of activities; for example, emergency treatment only, rehabilitation only, comprehensive treatment covering all needs;
6. social and political requirements or commitments.

Different opinions regarding stroke treatment pathways and infrastructure exist. The maximal solution may consist of a comprehensive stroke care; that is, treatment covering the whole period from the acute phase to the end of rehabilitation (Kaste et al., 2000). The minimal, but not necessarily the least, is the community-based home treatment (Bhalla et al., 2001).

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A recent systematic meta-analysis identified several types of stroke services. The most important finding was that all services should provide an organized care and use defined pathways (Stroke Unit Trialists' Collaboration, 1998, 2001). So-called dedicated stroke units can be distinguished as follows.

58.2.1. Acute stroke unit and acute stroke intensive care unit

This setting is defined by geographically clearly marked/restricted wards, where stroke patients are admitted and cared for. This category includes the "acute intensive stroke unit" or "acute stroke intensive care unit," which accepts patients acutely but discharges early; that is, usually within 7 days. Acute stroke units seem to improve care by themselves by alternating investigations as well as secondary prevention and reducing length of stay (Bath et al., 1996).

58.2.2. Acute stroke team

One approach for reducing the in-hospital delays by obtaining specialized medical care and by providing acute stroke care for stroke patients is the formation of so-called acute stroke teams, which are also referred to as stroke code teams in analogy to cardiac code teams. This is a common approach in the USA (Alberts et al., 1998) and in some hospitals in the UK (Kalra et al., 2000). Different specialists collaborate in stroke care and are available on request to advise on specific stroke-related issues. The team is thus based on organization not on geography, and the patient may be treated in the most extreme case on any ward of any appropriate hospital.

58.2.3. Stroke rehabilitation units

Stroke rehabilitation units only accept patients after the acute phase of the disease; that is, with a delay of usually 7 days or more, and focus exclusively on rehabilitation. This type of organization will not be discussed further in this chapter.

58.2.4. Comprehensive stroke units

Comprehensive stroke units combine acute and rehabilitation stroke care. Here, patients may also be treated for a prolonged time (Stroke Unit Trialists' Collaboration, 1998, 2001). Furthermore, comprehensive stroke units have to be able to deliver the wide variety of specialized care needed by patients with serious cerebrovascular disease comprising health care personnel with specific expertise in a number of disciplines, advanced neuroimaging capabilities, cerebral angiography, endovascular techniques, carotid endarterectomy, intra-arterial thrombolytic therapy, and other specific infrastructure and programmatic elements; for example, intensive care unit as well as a stroke registry. An improvement of patients outcome is likely to be dependent on the integration of these elements into a coordinated hospital-based program or system (Stroke Unit Trialists' Collaboration, 1998; Alberts et al., 2005).

58.3. Mandatory components and goals

Any of the above-mentioned facilities can only work efficaciously provided that a clear organization scheme is present. It is mandatory to establish algorithms that determine patient evaluation, any diagnostic workup, treatment, rehabilitation procedures, as well as staff responsibilities and duties.

58.3.1. Responsible physician

A responsible physician with specialized knowledge has to be appointed to lead the stroke unit. This raises the question about mandatory qualification. This person should implement the stroke unit, adopt and develop the concept to local needs, select and supervise the staff and be responsible for the continuous training of the stroke team members. This issue has not often been addressed so far. A neurologist with training in stroke medicine or an internist or geriatrician with strong interest in neurology might be regarded as particularly suitable if they acquired specialized knowledge (Helsingborg Conference, 1995). Warlow et al. (2001) do not specify what kind of physician is most apt to give treatment to stroke patients. They state that the physician should have broad knowledge about pathologies underlying stroke as well as the functional problems related to this disease. His broad knowledge qualifies him to lead the stroke team. The neurologist can provide knowledge on clinical diagnosis, interpretation and consequences of neurological impairment. Moreover, a neurologist may be more aware of stroke in the posterior fossa than untrained physicians (Stroke Unit Trialists' Collaboration, 1998; Lyrer et al., 1999). Recent reports suggest that treatment by neurologists in the acute phase may be more expensive, but outcome is better overall (Alberts et al., 1998; Smith et al., 1999). As stroke patients suffer from a broad range of symptoms, their care requires input from several disciplines.

58.3.2. Type of organization

Different types of stroke unit organization can be identified. Several models have been described, but

few have been evaluated. Stroke units are far from being homogeneous. There are on the one hand acute stroke units (Levine, 1989) or intensive care units (Langhorne, 1995; Langhorne and Dennis, 1998) mainly designed to provide care for patients in the acute phase and not focusing on rehabilitation. Their aim is to avoid systemic complications and to rapidly detect deteriorating stroke as changes in a patient's assessment often occur in the first few hours after onset. On the other hand, non-intensive stroke units or stroke rehabilitation units exist, where a patient is transferred to for rehabilitation, which is regarded as the main aim. These units are usually discrete stroke wards. Furthermore, there are stroke wards taking care of patients starting in the acute phase until full rehabilitation. A further approach is to create mobile stroke teams in acute care hospitals as well as in rehabilitation hospitals with the aim of providing skilled treatment at every stage of the illness.

Every stroke unit should in any case be dedicated to provide (Langhorne, 1995; Langhorne and Dennis, 1998):

1. a comprehensive assessment of the patient's illness and disability;
2. development, and implementation of a collaborative policy for stroke management;
3. identification and awareness of objectives of rehabilitation;
4. close multidisciplinary collaboration;
5. focus on the education and research activity.

An easy access to a stroke service for patients has to be aimed at. Furthermore, a reduction of in-hospital delays of stroke treatment by adequate measures; for example, by establishing a phone call system, is regarded as essential (Gomez et al., 1994).

58.3.3. Infrastructure and facilities to run a stroke unit

As strokes occur at any time of the day and are considered medical emergencies, an emergency room should be accessible on a 24-hour basis. The assessment of patients and close monitoring has to be warranted. A minimal amount of diagnostic tools should be available on site, namely 24-hour cranial computer tomography (CCT) scan facility, a 24-hour neurosonology examination on request, routine laboratory tests, cerebral angiography, and intensive care unit. Emergency CCT diagnosis is mandatory in order to diagnose intracerebral hemorrhage and is used on an emergency basis especially for ischemic stroke patients qualifying for thrombolytic treatment. Neurosonology examinations are needed to perform screening of large-artery cerebrovascular diseases, and are requested as soon as emboli from large arteries are suspected. Laboratory facilities are mandatory for blood cell count and to detect electrolyte and metabolic disturbances in the acute stage. The option of transferring a patient to an intensive care ward, if necessary, is essential in order to avoid early systemic complications and to closely monitor impairment as well as cardiovascular functions. Rapid access to neurosurgical operation procedures is also mandatory (Kaste et al., 2000).

A recent expert survey divided the current available facilities providing stroke care for acute stroke patients into the following three types: comprehensive stroke centers, primary stroke centers, and any hospital ward admitting acute stroke patients in an emergency, as a matter of routine (Leys et al., 2007). "Comprehensive stroke centers" were defined as centers with the necessary staffing, infrastructure, expertise and programs to provide appropriate diagnosis and treatment for stroke patients who require a high intensity of medical and surgical care, specialized tests or interventional therapies: (1) to act as referral center for other hospitals in their area; and (2) to be an educational resource for health care professionals (Alberts et al., 2005). "Primary stroke centers" were defined as centers with the necessary staffing, infrastructure, expertise, and programs to provide appropriate diagnosis and treatment for most stroke patients (Alberts et al., 2000). Although primary stroke centers provide high-quality care, some patients with rare disorders, complex strokes, or multi-organ diseases may need more specialized care and resources not available in these centers (Alberts et al., 2000). "Any hospital wards" were defined as any hospital where general acute care is provided, and where more than 50 acute stroke patients are admitted per year, even if there is no stroke unit or even if patients are subsequently transferred to a primary or to a comprehensive stroke center. Eight components were considered mandatory by more than 75% of the experts for both comprehensive stroke centers as well as for primary stroke centers: multidisciplinary team, stroke-trained nurses, 24/7 brain CT scan, CT priority for stroke patients, extracranial Doppler sonography, automated ECG monitoring, 24/7 intravenous rtPA protocols, and in-house emergency department (Leys et al., 2007).

58.4. Evidence of efficacy

58.4.1. Specifically established pathways for stroke care

With the aim of establishing a meta-analysis for stroke care, the Stroke Unit Trialists' Collaboration identified

the following stroke pathways that provided information by randomized controlled trials.

58.4.1.1. Dedicated stroke unit

This is a disease-specific service provided by a discrete stroke ward or stroke team working exclusively in the care of stroke patients. The service can be based in a geographically discrete ward or comprise a peripatetic team. This category included the following: (a) acute (intensive) stroke units which accept patients acutely but discharge early (usually within 7 days); (b) rehabilitation stroke units which accept patients after a delay of usually 7 days or more and focus on rehabilitation; and (c) comprehensive stroke units (i.e., combined acute and rehabilitation) which accept patients acutely but also provide rehabilitation for at least several weeks if necessary. Both the rehabilitation unit as well as the comprehensive unit offer prolonged periods of rehabilitation.

58.4.1.2. Controlled randomized trials

Several controlled randomized trials aimed to show the efficacy of different types of stroke unit care. By itself the results of each trial give a very heterogeneous picture, and no definite conclusion can be drawn. For a few years, the Stroke Trialists' Collaboration has provided data from meta-analysis of all available data on stroke unit care. Data could be extracted from more than 25 controlled randomized trials and allowed the following estimate of efficacy (Stroke Unit Trialists' Collaboration, 1998, 2001).

58.4.1.3. Effect on death

In the cited meta-analysis, data from 20 trials on the principal outcome of death at final review were available. This analysis is based on the service comparisons within the original trials where a novel intervention was compared with the contemporary conventional care (alternative services). Case fatality recorded at final review (median follow-up 12 months; range 6 weeks–12 months) was lower in the organized (stroke unit) care in 15 of the 20 trials. The overall estimate gives an odds ratio of 0.86 (95% confidence interval 0.71–0.94, $p = 0.005$). The odds ratio of death was not considerably changed if the analysis was restricted to trials where scheduled follow-up was continued for a fixed period of 6 months or 1 year.

58.4.1.4. Effect on death or institutional care

The second outcome examined was the odds ratio of death or condition requiring institutional care at the end of follow-up (median = 1 year after stroke). Institutional care is an important outcome, as it may be unbiased. The summary result was highly significant (0.80, CI 0.71–0.90; $p = 0.0002$), but some heterogeneity existed between trials attributable to five analyzed trials that had a very short or variable period of follow-up. Trials with a fixed prolonged period of follow-up showed a significant reduction in death or institutionalization with less heterogeneity.

58.4.1.5. Effect on death or dependency

The third outcome examined in the meta-analysis was the combined adverse outcome of being dead or dependent in activities of daily living at the end of follow-up. The overall odds ratio for being dead or dependent if receiving organized (stroke unit) care rather than conventional care was 0.78 (0.68–0.89; $p = 0.0003$), and the summary result showed some minor heterogeneity. The main reason for this may lie in the nature of the control group. The results were less heterogeneous and the odds ratio remained significant where (stroke unit) care organized was compared to conventional care provided in a general medical ward. The conclusions were not altered by the exclusion of trials with a variable follow-up period or informal randomization procedure. The main methodological difficulty when using dependency as an outcome is the degree of blinding at final assessment and the potential for bias if the assessor is aware of the treatment allocation.

58.4.1.6. Age

As the severity of stroke is not age-related, age should not be taken into account for decision-making as far as admission to a stroke unit is concerned. Elderly people, however, are more likely to have a less favorable outcome. Still, each individual should get a maximal treatment to reduce disability. As prognosis may very significantly depend on the clinical syndrome, priority should be given to patients with certain specific syndromes. There is no clear evidence so far whether any clinical neurological syndrome should be excluded from treatment in stroke units. Patients with lacunar syndromes are likely to be less disabled compared to patients with cortical syndromes, even though exceptions to this do exist. As the etiology is usually still unknown when the patient enters an emergency room, etiologic factors cannot be taken into account for decision-making whether a patient should be admitted to a stroke unit or not. Etiological factors are the basis of secondary stroke prevention, but not for decision-making. In the previously mentioned meta-analysis, the patient subgroup analysis for death or institutional care showed a similar odds ratio (95% CI) for the age group up to 75 years of 0.77 (CI 0.63–0.94) and an

even more favorable value for the more elderly; that is, over 75 years, of 0.71 (0.57–0.90).

58.4.1.7. Long-term follow-up

Until now, one clinical controlled trial could recall data from patients 10 years after initial treatment. The effect of stroke unit treatment was still present 10 years after admission for an initial stroke. It is therefore concluded that stroke unit care has a long-term benefit, which is measurable until 10 years later (Indredavik et al., 1999).

58.4.1.8. Number needed to treat

The risk difference for each outcome was calculated as the absolute difference in outcome in each trial pooled for all available trials. This information was used to calculate the number needed to treat to prevent one adverse event. On average, the number needed to treat to prevent one death was calculated to be 32 (95% CI 18–200), that to prevent one patient from being unable to live at home was 16 (10–43) and that to prevent one patient from failing to regain independence was 18 (11–45). There could, however, be a wide range of results as both the confidence intervals and the base line outcome rates vary considerably.

Data from large randomized trials are missing so far. Yet, a recent retrospective blinded analysis showed that stroke unit care within wards with specifically dedicated beds and staff admitting stroke patients within 48 hours are superior to a conventional ward. The probability of being disabled or dead at the end of follow-up after 20 months had an odds ratio of 0.81 (95% CI 0.72–0.91) in favor of stroke wards. The sample size was large enough to be significant (11,572 patients) (Candelise et al., 2007).

58.4.1.9. Patient satisfaction and quality of life

Two trials (Indredavik et al., 1991; Berman et al., 1994) recorded outcome measures related to patients' quality of life. In both cases, there was a pattern of improved results within the stroke unit survivors with the results attaining statistical significance in the Trondheim trial (Indredavik et al., 1991). There was no information on any systematically gathered information on patients' preferences.

58.4.1.10. Length of stay

Length of stay data was available for 16 individual trials from the meta-analysis. Mean (or median) length of stay ranged from 13 to 162 days in the stroke unit groups and 14 to 137 days in the control groups. Nine trials reported a shorter length of stay in the stroke unit group, and seven a more prolonged stay. The calculation of a summary result for the length of stay was subject to major methodological limitations, such as different ways of calculation of the length of stay or trials that recorded median rather than mean length of stay. Overall, there was a modest reduction in the length of stay in the stroke unit group, which approximately corresponded to a reduction ranging from 2 to 11 days. Finally, the length of stay is mainly determined by local conditions and organization. It seems not warranted to claim that stroke patients should stay in one place from entry until discharge. It may be equally effective to separate an acute phase of a few days designated to the treatment of the initial lesion as well as consecutive acute complications, from a second phase dedicated to rehabilitation (Stroke Unit Trialists' Collaboration, 1998, 2001).

At present, there are also services following the strategy of discharging home early, but at the same time offering community-based rehabilitation. However, there is neither clear evidence of risk and benefit nor of cost effectiveness (Early Supported Discharge Trialists, 2005). So far, these models need further evaluation and cannot be propagated at the present stage.

Appropriately resourced early supported discharge (ESD) services provided for a selected group of stroke patients can reduce both long term dependency and admission to institutional care as well as length of hospital stay. No adverse impact was observed on the mood or subjective health status of patients or carers (Early Supported Discharge Trialists, 2005).

58.4.1.11. Pre-hospital treatment

There are virtually no data on admission pathways. By empirical decision making it seems rational to avoid any delay in transfer of patients to an adequate institution. This requires a higher awareness of the possibility of potentially efficacious treatment of stroke in public and among family physicians and emergency organizations. In order to optimize therapeutic potential, the highest number possible of patients should be admitted (Helsingborg Conference, 1995). Of course, many of these patients will eventually not require immediate treatment, but will need appropriate diagnostic work-up and start of secondary prevention. This is true in the case of existing institutions, which are able to treat acute stroke patients.

58.4.1.12. Avoiding hospitalization after stroke

Another systematic Cochrane review deals with the need of hospitalization of stroke patients (Langhorne et al., 1999). In the UK, it has become increasingly fashionable to develop alternatives to hospital-based

care for a number of conditions including stroke, which are often called "hospital-at-home." In a recent UK survey, over 100 schemes of this type were planned or underway (Shepperd and Iliffe, 1996). The underlying rationale bases on the facts that these services not only provide equivalent or better patients' outcome at lower cost, but are also preferred by patients and care-givers. The corresponding trials are characterized by considerable heterogeneity hardly allowing specific conclusions. Therefore drawing conclusions seems only reasonable for broad policy choices rather than for specific service designs; for example, whether the availability of home-based alternatives to hospital care does improve outcome and does reduce resource use. The review indicates that such an approach has yet to prove to have an advantage over conventional services (which often involve hospital admission). The authors have not been able to identify any significant differences in patient or care-givers' outcomes. Furthermore, despite an apparent reduction in the number of patients admitted to hospital, there was no overall reduction in hospital bed use, which suggests that the novel (intervention) services are not cheaper and might be even more costly than conventional care (Langhorne et al., 1999). However, there are concerns about the heterogeneity of the control service provision. The control services usually included the option of admission to hospital to a general medical service, which is no longer regarded as adequate (Stroke Unit Trialists' Collaboration, 1998, 2001). Any future trials should compare home care services to the best available in-patient care (organized stroke unit care). In view of the heterogeneous nature of the trials reviewed, it might be argued that no pooling of data should be attempted. Even if this recommendation were followed, we would still be left with the conclusion that the availability of home care services to acute stroke patients has neither improved patients' outcomes nor reduced cost (Langhorne and Dennis, 1998). Thus, there is currently no evidence to support a radical shift of acute care from the conventional hospital-based setting to a home-based one for the majority of stroke patients.

A further recently published trial addressed this question. It aimed to compare the efficacy of stroke unit, stroke team, and domiciliary stroke care in reducing mortality, dependence, and institutionalization in patients with moderately severe stroke. It finally showed that organized stroke units are more effective than a specialist stroke team or a specialist domiciliary stroke care (Kalra et al., 2000). Mortality was significantly lower with 14% for stroke team care after 12 months than for stroke team or domiciliary stroke care with 24% and 30%, respectively (OR 0.5, CI 0.29–0.87, $p < 0.01$). This study provides further support for early specialist care on dedicated units for stroke patients.

58.4.1.13. Discharge and rehabilitation

Any type of follow-up treatment has to be carefully planned. It is important to adjust and coordinate patients' daily requirements in cases of discharge home. In cases of in-patient rehabilitation, it is important to prepare the patient for this next step, to choose the adequate institution, and to warrant information on follow-up information as well as on final outcome. It is not the aim of this chapter to describe rehabilitation-related procedures.

58.4.1.14. Effect of organization

One recent study assessed the effect of different type of stroke care organization: (a) acute stroke unit care (patients admitted within 36 hours of stroke onset and remaining for up to 2 weeks; $n = 5$), (b) units combining acute and rehabilitative care (combined; $n = 4$), and (c) rehabilitation units where patients were transferred onto the service approximately 2 weeks following stroke (post-acute; $n = 5$). Overall on one hand, specialized stroke services were associated with significant reduction in mortality, death and dependency, and length of hospital stay, yet the different types of care yielded unequal benefit (Foley et al., 2007). On the other hand, a former meta-analysis of the effect of different pathways for stroke care, did not show a statistically significant effect of different forms of hospital organizations (Kwan and Sandercock, 2004)

58.5. Economic issues

Stroke units appear to improve outcomes, but at what cost? No detailed cost–benefit analysis of stroke units has been carried out to date (Gladman, 1992), nor have the published trials provided enough detailed information to allow a detailed formal analysis. In cost terms, length of stay is likely to dominate any individual component of patient care. Studies from several developed countries (Warlow et al., 2001) have shown that fixed cost (particularly nursing staff salaries) account for over 90% of spending on patients with acute stroke. Remedial therapy represents only a small proportion of the total cost of hospitalization. In a recent analysis (Major and Walker, 1998), stroke unit care was not apparently associated with an increase in total health and social care cost but these conclusions were sensitive to some variations in cost estimates. More

research is required to elucidate the cost implications of stroke units. Setting up a stroke critical pathway leads to significant savings due to a decrease of length of stay (Bowen and Yaste, 1994).

In-patient costs vary depending on the type of stroke. In a recent estimate on stroke cost, patients with subarachnoid hemorrhage had the most cost-intensive treatment, followed by patients with intracerebral hemorrhage (Shelby et al., 2001). The least expensive were those with ischemic stroke and transient ischemic attacks. The average cost amounted to US$23,777 for subarachnoid hemorrhage, US$10,241 for intracerebral hemorrhage, US$5,837 for ischemic stroke and US$3350 for transient ischemic attack, respectively. It has to be taken into account that this estimate was issued in the USA, and that costs vary among institutions; for example, the costs were higher in teaching hospitals than in non-teaching hospitals. These data provide a judgement of hospital cost, but it will be much more difficult to estimate the personal cost as well as those of relatives and society cost. So far, there are no data available on cost-effectiveness for acute stroke treatment by prospectively collected data. Prospectively collected uncontrolled data on cost are able to demonstrate that hospital costs in the first days of occurrence are determined by several predictors such as length of stay, stroke severity, atrial fibrillation, ischemic cardiac disease, male sex, and the use of heparin (Diringer et al., 1999).

Overall the cost for stroke treatment varies a great deal between different countries and different types of stroke care. At least in Europe, there is a great variation of the processes of care, resources used and thus in stroke unit cost. The cost for one stroke within 3 months after onset vary from less than US$1,000 in Eastern Europe to approximately US$8,000–9,000 in London or Copenhagen. At present, it is not clear what kind of stroke care is the most cost-effective (Grieve et al., 2001). The formation of an acute stroke team creates no or only minimal additional cost. From this point of view, it will be wise to operate as many acute stroke teams as possible, as this seems to be one of the most cost-effective interventions (Alberts et al., 1998).

Modeling costs for a stroke unit gives estimates that the costs for stroke care decrease by approximately 3%. The transformation of a general ward to a stroke unit would then result in an amortization of investments within the first year (Laaser et al., 1999). Overall, there would be a savings in hospital as well as in community resources as patients are better off after a shorter hospital stay.

58.6. Establishing guidelines and education

Institutional guidelines are mandatory to any clinic that treats stroke patients. They must be compatible to published stroke unit pathways. Guidelines have to implement specifically local habits and have to consider the possibilities of the present infrastructure. It is not only important to create guidelines, but also to disseminate them and to teach their application (Langhorne, 1995; Langhorne and Dennis, 1998). These arguments created a series of different recommendations for stroke unit care in different countries; for example, the USA, in the European Community, or Switzerland, which are adapted to each medical system (Alberts et al., 2000, 2005; European Stroke Initiative Executive Committee and the EUSI Writing Committee, 2003; Engelter and Lyrer, 2004).

58.7. Continuous evaluation process

Once a stroke unit care pathway is established, quality control of the care given is mandatory. The availability of data draws the attention to possible failures and enables changes where required. Quality improvement proceeds most effectively if all elements of the quality triad, such as structures, processes, and outcomes are used in the assessment, provided that the structures and processes chosen have demonstrated to be associated with the desired outcome of care (Hammermeister et al., 1995). One of the most suitable tools is the use of a stroke database that catches the predefined and relevant items on processes and outcomes.

58.8. Conclusions

It can be stated that patients receiving organized in-patient (stroke unit) care are more likely to survive, regain independence and return home than those receiving contemporary conventional care. This apparent effect is of marginal statistical significance for case fatality. However, the observed reduction in the combined adverse outcomes (death or institutionalization, death or dependency) is much more statistically robust and warrants the institutionalization of stroke unit care. The requirement for long-term care is a useful surrogate for disability and is likely to show good inter-observer agreement. However, the absolute rates of institutionalization will be influenced by a variety of national and cultural factors (Stroke Unit Trialists' Collaboration, 1998, 2001). This is also true for the cost.

Methodological limitations may also have had an influence on the analysis of descriptive information about service organization (Stroke Unit Trialists' Collaboration, 1997, 1998; Stroke Unit Trialists' Collaboration, 2001). Service descriptions are collated retrospectively. The above-mentioned findings may therefore be biased in regard to the expectations of the authors, who ran an organized stroke unit care.

One has to keep in mind that subgroup analyses indicate that the observed benefits of organized stroke unit care are not limited to any one subgroup of patients or models of stroke unit organization. Apparent benefits are seen in patients of both sexes, aged under and over 75 years, and across a range of stroke severities. Therefore there is no reason to deny stroke unit treatment to any stroke patient at present.

The type of organization is of secondary importance. Three approaches to stroke unit care (comprehensive units, rehabilitation stroke units, and rehabilitation units) exist. All of them tend to be more effective than conventional care in a general medical ward. Apparent benefits can be shown for units with acute admission policies as well as for those with delayed admission policies and for units offering a period of rehabilitation of several weeks. Stroke patients who receive organized inpatient care in a stroke unit are more likely to be alive, independent, and living after the stroke. From the available data, it seems that the benefits are most apparent in units based in a discrete ward.

Stroke units appear to improve outcomes, but at what cost? No detailed cost–benefit analysis of stroke units has been carried out (Gladman, 1992). Available information on detailed cost analyses showed a heterogeneous picture with huge differences in stroke case cost within Europe. There is no sufficient information to allow a detailed formal analysis of cost effectiveness. In cost terms, length of stay is likely to dominate any individual component of patient care. Studies from several developed countries (Warlow et al., 2001) have shown that fixed cost (particularly nursing staff salaries) account for over 90% of spending on patients with acute stroke. Remedial therapy represents only a small proportion of the total cost of hospitalization. In a recent analysis (Major and Walker, 1998), stroke unit care was not apparently associated with an increase in total health and social care cost but these conclusions were sensitive to some variations in cost estimates. More research is required to elucidate the cost implications of stroke units.

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