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CLINICAL REVIEW

Post-acute care and secondary prevention after ischaemic stroke

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In the first part of this two part review (*BMJ* 2011;342:d1938) we discussed acute diagnosis and management of cerebrovascular events. Much of the focus of recent research, public health initiatives, and health policy has been around acute and hyperacute management of stroke. However, important goals of stroke care are to maximise functional recovery and prevent recurrent events. Here we draw on evidence from randomised trials and meta-analyses to discuss models of care, rehabilitation, and secondary prevention in stroke.

An important aspect of post-acute stroke care is rehabilitation. Rehabilitation research remains a “young” science, although an evidence base is emerging. As we make progress in this field, we need a common language to describe this important intervention. In the box we offer our own definition of stroke rehabilitation, although others may offer differing suggestions. Many questions remain unanswered regarding timing, optimal components, and frequency and intensity of rehabilitation. Further discussion of rehabilitation as a concept or rehabilitation theory specific to stroke is beyond the scope of this article, but recent high quality publications on the subject are available.^{w1 w2}

This review will focus on the early period after stroke. Effective early intervention may affect longer term outcomes,^{w3} with combined analysis of three UK stroke cohorts (n=7710 patients) showing that long term survival is predicted by functional outcome at six months.^{w4} Most interventional research in stroke has focused on these first days to months after a stroke event, whereas health needs and management of stroke survivors outside of this period has received little attention. This is unfortunate in a cohort with high incidence of residual disability and often complex comorbidity, and more work is needed to inform practice and policy.

How should I assess a patient who has survived a stroke?

Assessment in the first days after stroke will guide subsequent management. The aims are to ascertain the pathology and mechanism of the stroke, identify post-stroke complications, and describe initial impairments.

“Acute” brain imaging was discussed in the first part of this review and will not be covered here. Further investigation to identify a possible origin and guide treatment may include assessment of extracranial carotid arteries, heart structure, or arrhythmia. The potential deleterious effects of deranged “physiology” (temperature, blood pressure, glycaemic control) were also discussed in the previous review. Evidence for intervention remains inconclusive, although routine frequent monitoring of these parameters in the first 72 hours remains usual practice.

Regular (at least daily) assessments of neurological function are important in planning effective ongoing medical care and early rehabilitation. Longitudinal cohort studies suggest that early measures of disability predict longer term outcomes.^{w5} In the first days after stroke, neurological findings are dynamic. The National Institutes of Health Stroke Scale^{w6} and Glasgow Coma Scale^{w7} are often used initially as global measures. Deterioration suggests that further investigation is needed to exclude hemispheric oedema or haemorrhage. Therapists will plan intervention on the basis of early functional assessments of visuospatial awareness, sitting balance, and mobility. Later the focus of assessment will move to activity measures, using validated tools such as the Barthel index^{w8} or modified Rankin scale.^{w9}

Post-stroke dysphagia is common—occurring in up to half of patients—and is associated with an increased risk of aspiration pneumonia and poor outcomes related to disability, increased length of stay, and death.^{w10} Meanwhile, withholding oral intake presents a risk of dehydration and malnutrition. Routine early

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Extra material supplied by the author (see <http://www.bmj.com/content/342/bmj.d2083/suppl/DC1>)

Web references

Webfigure: Scoring algorithms to determine risk and benefit of oral anticoagulation in atrial fibrillation (non-valvular)

Summary points

The management of stroke patients within dedicated stroke units prevents disability and saves lives for patients of all ages, with all types and severities of stroke

Venous thromboembolism prophylaxis with compression stockings is not routinely recommended and may cause harm.

Early mobilisation and physiotherapy are recommended by guidelines and appear to be safe, although definitive data on efficacy are awaited

Medical complications after stroke are common and affect functional outcomes as well as mortality; infection, delirium, and dysphagia are potentially treatable

Early artificial feeding with percutaneous gastrostomy tube has not shown longer term benefit for stroke survivors with impaired swallow and nasogastric feeding is recommended for initial management

Secondary prevention with anti-hypertensive, anti-thrombotic, and lipid lowering drugs reduces likelihood of recurrent stroke

Stroke rehabilitation—a working definition

Stroke rehabilitation is not (usually) a single intervention; rather, it is an active process with a holistic, individualised focus. It usually involves teams made up of various professionals, the patient, and other relevant parties (such as carers), all with a final common goal of enhancing functioning to enable patients and carers to live their lives to the fullest potential. Based on Quinn and Langhorne, Oxford Desk Reference Geriatric Medicine, 2011.

Sources and selection criteria

This review is based on the authors' clinical and research experience and informed by a search of published literature. Electronic databases (Medline and Embase) were searched from inception to December 2010 inclusive, using truncated keywords: "stroke or cerebrovascular"; "rehabilitation"; "prevention". In addition key reference works, national and international guidelines, and journals were searched for relevant papers. Particular attention was given to large randomised controlled trials, systematic reviews, and meta-analyses. The intention was not to offer comprehensive systematic review but to give a narrative overview and critique of published work.

assessment of swallow is recommended by national guidelines.^{1,2} Assessment should be frequent; most patients with early dysphagia will regain swallow by the second week.^{w11} A bedside water swallow test (where a patient is asked to swallow a small volume of water) is a reasonable screening test^{w12} and will determine the need for formal assessment of swallowing. Such assessment is performed by speech and language therapists and is often complemented by functional imaging, such as video fluoroscopy.

What kind of care should be delivered in hospital?

Evidence of benefit of stroke units

In the past two decades many single centre trials highlighted poor outcomes associated with generic care compared with care undertaken in dedicated stroke units. A Cochrane review from 2007 of 31 trials (n=6936 participants) confirmed the benefits of organised specialist care for patients with stroke.³ Compared with general wards, the number needed to treat in a specialist unit was 22 to prevent one death and 16 to prevent one patient losing their independence, which compares favourably with other interventions for stroke (tables 1 and 2). The benefits of being cared for in a stroke unit extend to all ages, subtypes, and severities of stroke, and studies with longer follow-up suggest that benefits endure.^{w3, w13} An economic analysis alongside a randomised trial found that care in a dedicated stroke unit was cost effective.^{w14} The evidence clearly suggests that such a service should be available for all patients who experience a stroke.

What makes a stroke unit?

To tease out the components of an effective complex intervention can be a challenge.⁴ Although a systematic review has highlighted the importance of monitoring and treating complications,⁵ traditional medical input is unlikely to be the sole factor contributing to the success of a stroke unit. A survey of recent trials suggests that an essential component is the multidisciplinary team with a specialist interest in stroke, who provide an organised package of care coordinated through regular team meetings. The setting and achievement of goals requires collaboration of medical, nursing, and therapy staff in hospital and in the community and should be guided by the patient and carers.

Within this generic description, care in the stroke unit varies, and the definition of the "ideal" stroke unit is flexible. Many countries are pushing towards direct admission to stroke units, although other models of care were included in the Cochrane review.³ Although the benefits of immediate admission to stroke care seem intuitive (early specialist input, prompt intervention), robust supporting evidence is not available.

Recent research has focused on opening the "black box" of stroke unit care. The individual components that have been investigated and shown to be beneficial, potentially beneficial, or of uncertain benefit are summarised in the figure. Robust evidence is emerging for specific areas of stroke care and those with recent data have been selected for further discussion here.

Prevention of venous thrombosis

Stroke survivors are at substantially increased risk of developing deep vein thrombosis because they are immobile and often dehydrated.^{w15 w16} An open label randomised trial compared prophylactic low molecular weight heparin and unfractionated

heparin for the prevention of venous thromboembolism after acute ischaemic stroke, and showed that enoxaparin was effective and relatively safe in reducing ultrasound detected deep vein thrombosis, although whether a clinical benefit exists is uncertain.⁶ The trial did not compare heparin with placebo. The available data do not allow definitive advice on use of heparin, and further research about targeting this treatment to those at greatest risk is needed.^{w17}

The recently published Clots in Legs Or sTockings after Stroke (CLOTS) trials provided pragmatic data about use of thromboembolic prevention stockings. Compared with no stockings, thigh or knee length stockings did not significantly reduce the risk of deep vein thrombosis.⁷ There was a trend towards increased deep vein thrombosis in the group that used knee length stockings, and substantial rates of skin complications were reported with both types of stocking.⁸ Although the clinical implications of the CLOTS trials continue to be debated, routine use of stockings cannot be recommended on the basis of current evidence.

Feeding patients

The Feed Or Ordinary Diet (FOOD) family of large randomised trials assessed different aspects of nutrition after stroke. The first assessed routine oral supplementation in stroke survivors with intact swallow (n=4023)⁹ compared with normal diet, and found that routine supplementation did not improve outcomes or reduce complications (absolute risk reduction in mortality 0.7%, 95% confidence interval -1.4 to 2.7; overall mortality rates were 12% in groups receiving supplements and 13% in those with no supplements). However, these findings do not preclude the targeted use of supplements where there is evidence or risk of malnutrition. The second and third studies examined the relative merits of early feeding by nasogastric tube (n=859) or percutaneous gastrostomy tube (n=321) after stroke.¹⁰ Early tube feeding was associated with a trend towards reduction in risk of death (absolute risk reduction 5.8%, 95% confidence interval -0.8 to 12.5). By contrast, early feeding by percutaneous gastrostomy tube was associated with a trend towards increased risk of death or poor outcome (7.8%, 0 to 15.5). This finding is partly explained by the severity of stroke that requires artificial feeding; however, use of percutaneous gastrostomy tube is not a benign intervention and has associated short and longer term morbidity.^{w18 w19} Patients' preferences and quality of life after percutaneous gastrostomy tube feeding are poorly researched, but available data suggest no improvement in quality of life.^{w20} Based on these findings, early placement of percutaneous gastrostomy tubes is not advisable. Options for long term feeding are limited and percutaneous gastrostomy tube feeding may have a role in selected individuals, after discussion with the patient, relatives, and multidisciplinary team.

Mobilisation: how soon?

UK guidelines recommend by consensus that patients should sit out of their bed and become mobile as soon as their clinical condition permits. It seems intuitive that early mobilisation should reduce the sedentary complications of stroke (muscle wasting, thrombosis, pressure sores, hypostatic pneumonia) but there is limited evidence to support the practice. A Very Early Rehabilitation Trial (AVERT) is currently assessing the value of early mobilisation in a multicentre randomised controlled trial. Fears that early mobilisation may be harmful seem to be unfounded; initial results suggest that mobilisation within the first day is well tolerated and may prevent complications.^{w21}

Facilitating discharge

Patients and their carers have reported feeling afraid and unsupported at the time of discharge, and an interview questionnaire study has shown that inadequate provision of information is associated with poor satisfaction for stroke survivors and carers.^{w22} However, a recent systematic review and meta-analysis of randomised controlled trials that evaluated dedicated stroke liaison services found no evidence of efficacy compared with standard care in improving measures of extended activities of daily living and patient/carer subjective health status.¹¹

A prolonged inpatient stay is costly, and services are increasingly encouraged to facilitate an early return to the community. A 2005 meta-analysis of data from studies of early supported discharge concluded that a multidisciplinary, appropriately trained early supported discharge service can significantly reduce days in bed for stroke survivors with mild to moderate impairments, with no corresponding increase in readmission or morbidity¹² and with overall cost benefit.^{w23}

In view of the sound evidence base for stroke unit admission and early supported discharge for selected patients, it is unfortunate that recent UK audit data suggest continuing inequity of access to these services. It seems reasonable to speculate that universal delivery of evidence based post-acute stroke care would, through its impact on disability, result in lower incidence of stroke survivors needing institutional or additional domiciliary care, and ultimately would offer cost savings.

Antithrombotic following ischaemic stroke

The preventive efficacy of aspirin, clopidogrel, dipyridamole, and the coumarin anticoagulant warfarin have been evaluated, as monotherapy and (because of their differing mechanisms of action) in combination. (table 3)

For monotherapy, a large meta-analysis showed a 15% reduction in risk of vascular events with aspirin compared with placebo over two years.^{w41} A randomised trial showed a modest benefit of clopidogrel over aspirin in reducing vascular events, in a population that included patients with stroke related disease.^{w42} Dipyridamole has similar efficacy to aspirin but is associated with frequent adverse effects, mainly headache and gastrointestinal disturbance.^{w43}

A meta-analysis of trials showed that the combination of aspirin and modified release dipyridamole is better than aspirin monotherapy¹⁵ and equivalent to clopidogrel monotherapy for stroke prevention.¹⁶ Dipyridamole has little effect on non-stroke vascular events, suggesting that it has specific cerebrovascular efficacy. Combinations of aspirin and clopidogrel have been studied in two large trials, both of which found that any reduction in vascular events was outweighed by increased haemorrhagic adverse events.^{17 18} Bleeding rates with aspirin and clopidogrel in combination are similar to those with warfarin and the risks should not be underestimated.^{w44} Some patients at high risk may benefit from short term combination antiplatelet therapy; in a trial of 107 patients with carotid stenosis and active embolisation, dual antiplatelet therapy was associated with reduced embolic burden and a trend towards reduced events.¹⁹

Interpretation of antiplatelet trial data to guide clinical practice is complex. While current Scottish guidance suggests aspirin and modified release dipyridamole as routine therapy, the most recent National Institute for Health and Clinical Excellence assessment recommends clopidogrel because of its better tolerability. For example, in one large study, premature discontinuation of aspirin plus extended release dipyridamole

was substantially higher than with clopidogrel (1650 patients [16.4%] versus 1069 [10.6%], $P < 0.001$).^{w45}

Warfarin has been studied in patients with sinus rhythm and with atrial fibrillation. For those with sinus rhythm a series of trials has shown that any benefit of anticoagulation is outweighed by an increased risk of bleeding for all levels of stroke risk.²⁰ Patients with cardioembolic stroke face a particularly high risk of recurrence. Stroke risk in patients with atrial fibrillation can be stratified and scoring systems have been developed (webfigure) to guide choice of therapy. Regardless of the scoring system used, where a patient has sustained a cerebrovascular event, the risk of subsequent stroke is sufficiently high to warrant the use of warfarin where possible. In patients with atrial fibrillation treated with aspirin, the risk of first stroke is 2.7% per annum and risk of recurrent stroke 10%. Treatment with warfarin has been shown to reduce these risks to 1.5% and 4% respectively in a meta-analysis.²¹ A Cochrane review confirmed the benefit of warfarin compared with aspirin (odds ratio 0.49, 95% confidence interval 0.33 to 0.72), calculating 60 fewer annual recurrent strokes per 1000 patients treated with warfarin.²²

The timing of anticoagulant initiation after stroke is unclear. Large infarcts or major clinical deficits raise concerns about haemorrhage and decisions should be based on individual patients' characteristics. Some guidelines suggest starting therapy within 14 days. Although this is a reasonable general approach, patients must be considered individually—these data are from a single study ($n=225$) where less than half of the participants started warfarin within the first two weeks.^{w46}

Despite its clear efficacy, clinicians may avoid warfarin, perhaps fearing risk of haemorrhage and problems with monitoring and adherence. Risk of warfarin related bleeding complications can also be stratified (webfigure). Oral anticoagulation shows the classic “inverse care law”, with those at greatest risk of stroke least likely to receive therapy. For example, older cohorts have a raised prevalence of atrial fibrillation and greater risk of stroke, yet underuse of anticoagulation remains prevalent,^{w47} despite compelling evidence from a UK general practice based study that showed the efficacy and relative safety of warfarin in selected older patients.²³ A new generation of oral anticoagulants are showing promise in clinical trials and may widen delivery of anticoagulation.²⁴

How are common complications treated after stroke?

Common complications in the longer term after stroke include delirium, infection, depression, post-stroke pain, falls, and incontinence. All these complications may be underdiagnosed and have little evidence available to guide treatment, although they affect rehabilitation negatively and are strong predictors of poor functional outcome and mortality.^{13w24}

Delirium is a common complication after stroke; observational studies suggest an incidence of around 13–48% of patients^{w25} but assessment is complicated by the prevalence of concomitant communication deficits and dementia. The stroke insult itself may cause delirium, but infection is often a precipitant. The rate of nosocomial infection after stroke can be as high as 30%.^{w26} Pneumonia and urinary tract infections remain the most common infections, although they may be prevented by regular assessment of swallow and avoidance of urinary catheters.^{w27}

Post-stroke depression has been reported in a third of patients^{w28} but the validity of estimates is questionable because the best method for screening or diagnosis is uncertain. A systematic

review found that drug treatment can improve mood and reduce excessive emotions but had frequent side effects, and there was no robust evidence of benefit for non-drug treatments.^{w29}

Post-stroke pain is multifactorial in origin, with important components including neuropathic pain and spasticity. Treatments that have been assessed for specific causes of pain include tricyclics, anticonvulsants, and botulinum toxin; evidence of their benefit is emerging but high costs and side effects may limit their widespread use. Shoulder pain in a paretic limb is increasingly recognised.^{w30} Robust evidence to guide management of such pain is lacking,^{w31} although suggestions are available for best practice in assessment and intervention.^{w32}

Falls are common both in the acute setting and in the longer term after stroke.^{w33} Putative risk factors include dementia, depression, polypharmacy, and sensory impairment.^{w34} The incidence of fracture is substantial (twofold increase in risk of hip/femur fracture^{w35}) in the post-stroke population.^{w36} Interventions to reduce risk of fracture are extrapolated from studies in older people that were not limited to those who had had a stroke; no stroke specific data are available. Preventive treatments may include bisphosphonates and preparations of calcium vitamin D, and multidisciplinary prevention packages that focus on personal and environmental factors. A recent systematic review and meta-analysis has highlighted the need for future randomised controlled trials in this area; it found evidence only to support vitamin D supplementation in a female population in hospital.^{w37}

Prevalence of urinary incontinence is estimated at 40–60% in an acute stroke population, with 15% remaining incontinent at one year.^{w38} Causes may include abnormalities of normal central control of voiding, lower urinary tract infection, and functional incontinence. A Cochrane review evaluated the limited evidence on physical interventions such as bladder retraining and pelvic floor exercises, and drug treatment, which may have a role in selected patients.^{w39}

What measures help to prevent another stroke?

The risk of recurrent vascular events after a stroke or TIA is substantial. Recurrent stroke has been reported in 17.3% of patients after TIA and 18.5% after minor stroke at three months.^{w40} National guidelines suggest that secondary preventive strategies be commenced early and continue indefinitely.^{1 14}

Management of carotid disease

International guidelines recommend that survivors of stroke are investigated for large artery atherosclerosis, particularly ipsilateral extracranial carotid artery disease.²⁵ Where imaging confirms stenotic carotid disease, patients with non-disabling events may benefit from surgical carotid endarterectomy. As a general rule, all patients with greater than 50% symptomatic internal carotid stenosis should be considered for intervention in the setting of a neurovascular multidisciplinary team. The benefits of intervention vary with degree of stenosis and time since event. A pooled analysis of data from randomised controlled trials of endarterectomy for symptomatic carotid stenosis (6092 patients) showed that for severe symptomatic stenosis (>70%), surgery afforded a 15.6% absolute risk reduction in ipsilateral ischaemic stroke over five years versus medical treatment alone, with a smaller 4.5% absolute risk reduction for moderate (50–69%) stenosis.²⁶ Surgery carried no benefit in less severe disease or in cases of complete occlusion. Greater benefit is seen with early surgery. Treatment within two

weeks of symptoms afforded an absolute risk reduction of 23%, by comparison with absolute risk reduction of 7.4% for those treated after 12 weeks. In order to prevent one ipsilateral stroke at five years, the number needed to treat is five within two weeks and 125 if surgery is delayed beyond 12 weeks.²⁷ The benefits of early treatment are particularly pronounced in women, where significant efficacy of revascularisation is seen only in the first two weeks.^{w48}

Percutaneous stenting of carotid vessels has been proposed as a less invasive method of revascularisation, but studies have failed to show that stenting has the long term benefits of traditional endarterectomy. Risk and benefit may change as technical expertise develops but present guidelines do not recommend stenting outside clinical trials.²⁸

How to manage hypertension

Management of hypertension in the acute phase was discussed in the first part of this review. Long term management of hypertension significantly reduces the risk of recurrent events. Meta-analysis of secondary prevention trials showed a 24% reduced odds of recurrent stroke with antihypertensive treatment (odds ratio 0.76, 95% confidence interval 0.63-0.92; absolute rate of recurrent stroke 10%).^{w49} Risk reduction is related to change in blood pressure and substantial benefit is seen even with a modest change in pressure. An overview of published reviews including more than 188 000 participants, showed that for each 10 mm Hg reduction in systolic pressure, risk was reduced by one third. This finding was consistent across sex, region, and stroke subtypes.²⁹

Evidence clearly indicates that all patients should be considered for antihypertensive therapy to prevent recurrent stroke. UK guidelines suggest a target blood pressure of 130/80 mm Hg; for most patients this will require at least two agents, one of which should be a diuretic.²⁸

The large PROGRESS trial has been pivotal in guiding post-stroke blood pressure management.³⁰ Treatment with the ACE inhibitor perindopril, in combination with the thiazide indapamide, showed a 26% reduced risk of stroke (95% confidence interval 16% to 34%) compared with placebo. Patients were considered for inclusion regardless of baseline blood pressure and benefits were seen even in those traditionally defined as normotensive.

Choice of antihypertensive agent may be important. In one pooled analysis the strongest evidence was for diuretic based therapy (odds ratio 0.63, 95% confidence interval 0.55 to 0.73).^{w50} Theoretical benefits of angiotensin receptor antagonists in stroke prevention have not been supported by large scale trials.^{w51}
^{w52}

Treating high cholesterol, diabetes and lifestyle risks

The stroke related benefits of statin treatment were originally described through sub-analyses data relating to ischaemic heart disease. In a large pooled analysis of data from coronary disease trials, statin treatment significantly reduced the risk of incident stroke (odds ratio 0.79, 95% confidence interval 0.73 to 0.85).³¹ The SPARCL trial (n=4731), a stroke specific placebo controlled study of statins (atorvastatin 80 mg), showed a reduction in incident ischaemic stroke (number needed to treat 45 over five years) and other vascular events, but a rise in incident haemorrhagic stroke (number needed to harm 107 over five years).^{w53} UK guidelines recommend treating to a total cholesterol of less than 4.0 mmol/L and LDL less than 2.0

mmol/L.²⁸ Statins are not recommended after intracerebral haemorrhage unless indicated for other vascular disease.

Observational studies have suggested a high prevalence of occult diabetes in stroke cohorts, which suggests that screening for diabetes may be useful after stroke. Although diabetes is an important risk factor for vascular events, no specific guidelines are available for optimal therapy in patients with stroke. A subgroup analysis of the PROactive trial described a reduced incidence of stroke with pioglitazone in selected patients³² but the findings must be interpreted in the light of other risks associated with thiazolidinediones. Several large randomised controlled trials have compared aggressive glycaemic control with standard therapy. Although these studies were not designed to measure stroke outcomes, they did not show reduced incidence of stroke with tight glycaemic control.^{w54}

No data from randomised controlled trials are available to guide lifestyle modification in patients with stroke. Compelling observational data support cessation of smoking.^{w55} The relation between alcohol and cerebrovascular risk is controversial. Meta-analysis of 84 observational studies described a "J-shaped curve" where lowest vascular risk was associated with modest intake, but specific stroke risk was increased at intakes of more than one unit daily.^{w56} Controlled weight reduction in overweight patients and physical activity have been associated with improvements in blood pressure, cholesterol, and diabetes. There are no stroke specific data on dietary modification, although routine vitamin supplementation probably has no benefit.³³

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Additional educational resources*Resources for healthcare professionals*

Stroke Association Professional Training (www.stroke.org.uk/professionals/training_and_development/index.html)—A selection of training and education programmes offered by the stroke association, suitable for all healthcare professionals

European Stroke Organisation (www.eso-stroke.org)—Comprehensive access to European stroke guidelines and educational resources for health professionals and lay people

UK Stroke Research Network (www.uksrn.ac.uk)—Provides an infrastructure to facilitate stroke research and improve communication between academics, stroke clinicians, stroke service users, and research funders

Stroke Training and Awareness Resources (STARS) project (www.stroketraining.org)—Commissioned by the Scottish Government to provide an e-learning resource for all healthcare professionals and social care staff working with patients affected by stroke

Resources for patients

The Stroke Association (www.stroke.org.uk)—Produces a number of publications to help educate and inform and increase awareness of stroke, including patient leaflets, and *Stroke News* (a quarterly magazine)

Act FAST campaign (www.nhs.uk/actfast/Pages/stroke.aspx)—Public awareness campaign to improve community recognition of stroke symptoms and encourage those affected to seek urgent medical help

Connect (www.ukconnect.org/index.aspx)—communication disability charity for patients and carers affected by aphasia
Carers UK (www.carersuk.org)—charity providing support for home carers

Tips for non specialists

- Refer all patients with suspected stroke to the local dedicated stroke unit
- Stroke survivors with ipsilateral carotid disease may benefit from revascularisation. Outcomes are best when intervention is performed early; liaise with a vascular multidisciplinary team
- Look out for common post-stroke complications such as infection, delirium, depression, pain, incontinence, and falls
- Treat hypertension aggressively and ensure that patients receive long term thromboprophylaxis
- Consider anticoagulation for all stroke survivors with atrial fibrillation, remembering that age alone is not a contraindication to anticoagulation

Questions for future research

- What is the optimal model for deep vein thrombosis prophylaxis for patients with ischaemic stroke?
- What is the optimal timing and intensity of multidisciplinary intervention? Can this be targeted?
- Is there a role for screening stroke survivors for common complications; do we have adequate tools to inform a screening approach?
- Can we develop novel drugs to minimise recurrent disease and provide alternative strategies for intolerant patients; are novel anticoagulation treatments cost effective?
- What is the role of short duration, high potency antithrombotic therapy following ischaemic stroke?
- What happens to stroke survivors' functional status in the longer term (years) post-event; is there a role for ongoing or opportunistic intervention and rehabilitation?

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Tables

Table 1 | Potential population impact of acute stroke interventions for a hypothetical population of one million with 2500 strokes per year³⁴

Treatment	Efficacy (extra independent survivors (n))*	Eligibility (proportion stroke population)	Effectiveness (number of extra independent survivors†)
Aspirin in acute ischaemic stroke	25	80%	20
Thrombolysis in ischaemic stroke			
rt-PA within 3 hours	280	10%	28
rt-PA within 3-4.5 hours	125	10%	12
Basic stroke unit care	125	80%	100
Early supported discharge teams and home rehabilitation	120	35%	42

rt-PA=tissue plasminogen activator. Calculations indicate number of extra independent survivors (modified Rankin score 0-2) resulting from an intervention during a one year period. *Assuming all stroke patients are eligible for treatment. †Taking into account population eligible for treatment.

Table 2 | Summary of patient outcomes in the stroke unit trials³

Outcome	Stroke unit	Conventional care	Extra events per 100 patients (95% CI)
Home (independent)	44 %	38%	5 (1 to 8)*
Home (dependent)	16%	16%	0 (-2 to 3)
Institutional care	18%	20%	-2 (-5 to 0)*
Dead	22%	26%	-3 (-6 to -1)*

Proportion (%) of patients with various outcomes at the end of scheduled follow-up (median one year), based on data from Stroke Unit Review (n=6900).

* P<0.05 for difference between groups.

Table 3| Evidence for antiplatelets in stroke preventionw57-w59

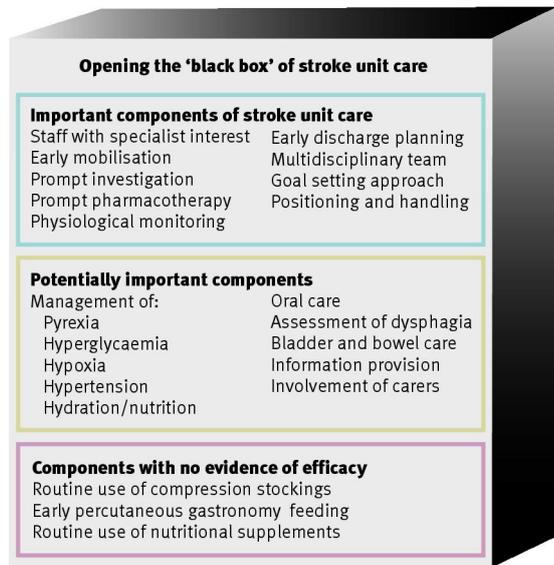
Antiplatelet and comparison		Comparator	Result for stroke	Comments
Aspirin	>	Placebo	RR 0.78 95% CI 0.61 to 0.99	AT secondary prevention analysis
Dipyridamole	>	Placebo	RR 0.88(95% CI 0.81 to 0.95)	SR (n=23.19 with ischaemic stroke)
Aspirin + dipyridamole MR	>	Thienopyridines (clopidogrel)	RR 0.76 95% CI 0.65 to 0.89	SR 4 RCT (n=1611)
Aspirin	<	Clopidogrel	OR 0.91, 95% CI 0.84 to 0.98	SR 4 RCT (n=86 865)
Aspirin + dipyridamole MR	□	Aspirin	HR 1.01 (95% CI 0.92 to 1.11)	RCT (n=20 332)
Aspirin + clopidogrel	□		RR 0.93 (95%CI 0.83 to 1.05)	SR (n=15 603 with risk factors)
Aspirin + clopidogrel	□ *	Clopidogrel	RRR 6.4% 95% CI -4.6 to 16.3)	RCT (n=7599 with risk factors)
(Aspirin +) dipyridamole + clopidogrel		–	–	On-going multicentre trials

Data are for ischaemic stroke secondary prevention unless otherwise stated; references for individual trials and analysis within main body of text.

> indicates greater efficacy than; < indicates lesser efficacy than; □ indicates equivalent efficacy; RR=relative risk; OR=odds ratio; HR=hazard ratio; RRR=relative risk reduction; AT=antiplatelet trialists; SR=systematic review; RCT=randomised controlled trial.

*Increased risk of life threatening or major bleeding seen with addition of aspirin.

Figure



Components of effective stroke unit care subject to randomised trials (based on Langhorne et al⁵)