SYLLABUS

TC06: Stroke

Sunday, November 13, 2011 14:30-18:00 Hall L

Marrakesh, Morocco, November 12-17, 2011

XXth WORLD CONGRESS OF NEUROLOGY

XXth WCN 2011 MARRAKESH World Congress of Neurology

WFN

SMN SOCIETE MAROCAINE DE NEUROLOGIE

WCN Education Program

Sunday, 13 November, 2011

14:30-18:00

STROKE

Chairpersons: **José M. Ferro**, *Portugal*
Ka Sing Lawrence Wong, *Hong Kong S.A.R.*

14:30 **PART I**

INTRACRANIAL ATHEROSCLEROSIS
Ka Sing Lawrence Wong, *Hong Kong S.A.R.*

NEUROVASCULAR TREATMENT FOR ACUTE STROKE
Antoni Dávalos, *Spain*

TREATMENT OF SYMPTOMATIC CAROTID STENOSIS
Werner Hacke, *Germany*

16:00 *Coffee Break*

16:30 **PART II**

ORGANIZATION OF ACUTE STROKE CARE
Stephen M. Davis, *Australia*

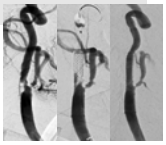
PREVENTION OF CARDIOEMBOLIC STROKE
José M. Ferro, *Portugal*

THROMBOLYSIS IN ACUTE ISCHEMIC STROKE
Nils Wahlgren, *Sweden*

Treatment of Symptomatic Internal Carotid Stenoses

The Evidence

Werner Hacke MD PhD FAHA FESC
Heidelberg, Germany



Disclosures

- No financial disclosures regarding this topic
- I was the principal investigator of SPACE and I am the principal investigator of SPACE II

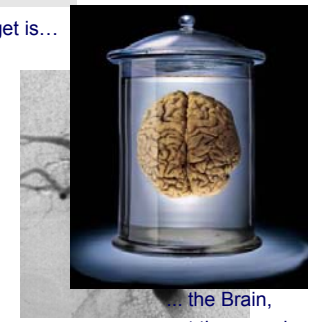
Prelude

- I assume that we are in agreement about the following statement

The objective of treating carotid stenoses is to prevent *ipsilateral* stroke

Carotid Interventions

The Target is…



… the Brain,
not the vessel

Background

- Carotid artery stenoses causes approximately 20% of all ischemic strokes
- Symptomatic carotid artery stenosis have a high recurrence risk
- Endarterectomy (CEA) is the established treatment of choice in symptomatic ≥70%^{NASCET} carotid artery stenosis[1]
- Stenting (CAS) was increasingly used and offered as an „established“ alternative to CEA

1: ESO Writing Committee Cerebrovasc Dis (2008); 25:457-507

Stenting: Evidence

- Until 2006 registries and underpowered RCTs only
  - Best you can say: feasible and relatively safe
- No evidence for equivalence or even superiority
- No such evidence for the use of protection devices
- Some unequivocal indications for stenting include
  - Post-radiation-stenoses
  - Unaccepable surgical risk
  - Surgically unaccesssable lesions
  - contralateral palsy of recurrent nerve

Stenting Registries

- Case series and registries
  - Problem
    - Mostly self-reported results, rarely independent neurological monitoring
    - Comparison of uncontrolled date with results of RCTs
  - What we know
    - It can be done
    - It seems safe
    - No proof of equivalence or superiority so far

    (Same is true for protection devices)

Recent large RCTs

- Trials published after 2006
  - SPACE***
  - EVA-3S*
  - ICST (CAVATAS II**)
  - CREST****

* Mas, NEJM 2006
** Brown, Lancet 2010
*** Ringleb, Lancet 2006
**** Brott NEJM 2010

SPACE 1: Results – Primary Endpoint (ITT)

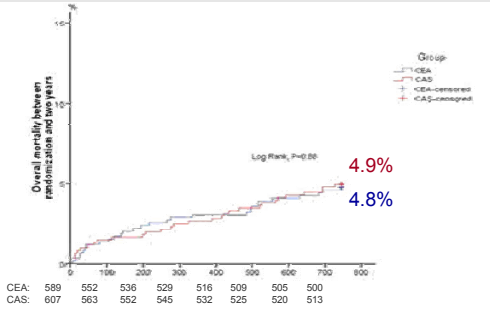
Ipsilateral stroke (any) and death between randomization and day 30

CAS (599)	CEA (585)
41	37
(6.84%)	(6.34%)

Absolute difference (95% CI): 0.51% (-2.37% to 3.39%); p=0.09

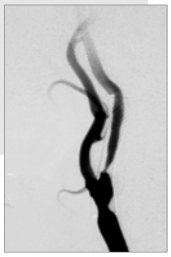
Odds ratio (95% CI): 1.09 (0.69 to 1.72))

Two year results (ITT)



Restenoses

- Assessed at day 7, 30, month 6, 12 and 24
- Based on ultrasound examination
  - no formal criteria for diagnosis of in-stent-restenosis
  - individual experience
  - central reading in process



Restenoses at 24 months

	CAS	CEA	OR (95% CI)
Intention-to-treat	54 / 607 (8.9%)	23 / 589 (3.9%)	2.40 (1.46 - 3.97)

Two (both after CAS) were symptomatic !

EVA 3S

- In short:
  - RCT comparing CAS and CEA in symptomatic ACI stenoses
  - Some experience of interventionalists required
  - After 20 patients, DSMC requested standard use of PD (5/20 endpoints without PD)
- Status at termination, required by DSMB
  - 527 patients randomized
    - 261 CAS vs 259 CEA
      - 7 excluded from ITT analysis

Mas NEJM 2007

EVA 3S - Result primary endpoint

CAS (N=261)	CEA (N=259)
25 (9,6%)	10 (3,9%)

Odds ratio 2,48 (95%CI 1,25 - 4,93)

Study prematurely terminated November 2005

Mas NEJM 2007

ICSS: Primary safety end point

	CAS n (%)	CEA n (%)	Hazard ratio (95% CI)	% difference	p
Stroke, MI, or death (ITT)	72 (8.5)	43 (5.1)	1.73 (1.18–2.52)	3.4	0.004

CAS=carotid artery stenting
CEA=carotid endarterectomy
ITT=intention to treat
PP=per protocol

Brown MM et al. European Stroke Conference 2009; May 27, 2009; Stockholm, Sweden.

ICSS: Primary end point cluster (ITT)

End point	CAS	CEA
Any stroke	65	34
Any myocardial infarction	3	4
Non-stroke, non-MI deaths	7	5

CAS=carotid artery stenting
CEA=carotid endarterectomy

Brown MM et al. European Stroke Conference 2009; May 27, 2009; Stockholm, Sweden.

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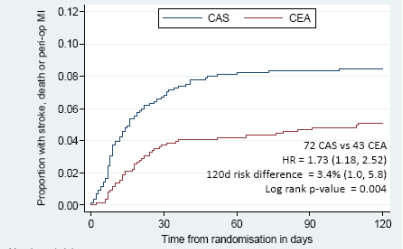
ICSS: Primary safety end point (ITT)



Brown MM et al. European Stroke Conference 2009; May 27, 2009; Stockholm, Sweden.

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Carotid Stenting trialist‘ collaboration

Short-term outcome after stenting versus endarterectomy for symptomatic carotid stenosis: a preplanned meta-analysis of individual patient data

Carotid Stenting Trialists' Collaboration*

- Single Data joined analysis of SPACE, EVA3S, ICSS
- n=3,433 Patienten

Bonati L ….Ringleb P: Lancet (2010); 376: 1062-1073

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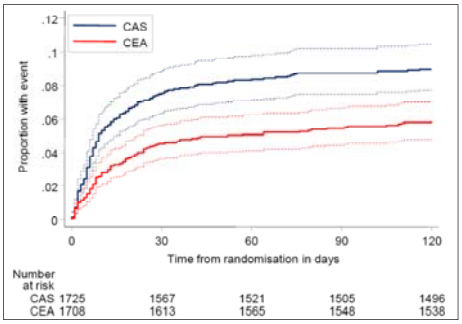
Update

CSTC Stoke and death up to 120 days



Update

CSTC Endpoints up to 120 days post randomization(ITT)

	CAS n=1725 *n (%)*	CEA n=1708 *n (%)*	Risk ratio (95% CI)	P-Wert	Risk diff. (95% CI)
Stroke or death	153 **8,9%**	99 **5,8%**	1,53 (1,2-1,95)	0,0006	3,2 (1,4-4,9)
Disabling stroke or death	82 **4,8%**	64 **3,7%**	1,27 (0,92-1,74)	0,15	0,9 (-0,4-2,3)
Mortality	32 **1,9%**	22 **1,3%**	1,44 (0,84-2,47)	0,18	0,7 (-0,2-1,5)
Any stroke	141 **8,2%**	84 **4,9%**	1,66 (1,28-2,15)	0,0001	3,3 (1,7-5,0)

Bonati L et al.: Lancet (2010); 376: 1062-1073

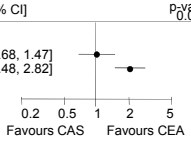
Joint analysis: **Results**

- Primary endpoint: any stroke or death
  - CAS group (153/1725 [8·9%])
  - CEA group (99/1708 [5·8%]),
    risk ratio (RR) 1·53, [1·20-1·95], p=0·0006; absolute risk difference 3·2 [1·4-4·9]).
- Explorative endpoint age
  - In patients <70 years old (the median age), the estimated 120 day stroke or death risk was 5·8% in CAS and 5·7% in CEA (RR 1·01 [0·68-1·47])
  - In patients 70 years or older, there was an estimated twofold increase in risk with CAS over CEA (12·0% versus 5·9%, RR 2·04 [1·48-2·82]

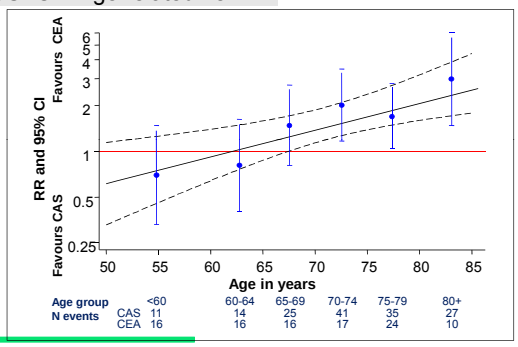
Bonati et al Lancet 2010

CSTC : Age effects: Stroke and death

	CAS Risk %	CAS Pts. N	CEA Risk %	CEA Pts. N	Risk ratio [95% CI]	Interaction p-value
Age						0.0053
< 70 y	**5.8%**	869	**5.7%**	843	**1.01** [0.68, 1.47]	
≥ 70 y	**12.0%**	856	**5.9%**	865	**2.04** [1.48, 2.82]	



CSTC – Age related risk



Joint analysis: **Interpretation**

- The short-term outcome is superior after endarterectomy compared with stenting, due to an increased risk of stroke associated with stenting in elderly patients.
- Stenting may be as safe as endarterectomy in younger patients, but determination of the efficacy and ultimate balance between the two procedures requires further data on long-term stroke recurrence.

Bonati et al Lancet 2010 in press

CREST
Carotid Revascularization Endarterectomy vs. Stenting Trial


The NEW ENGLAND JOURNAL of MEDICINE

ORIGINAL ARTICLE

Stenting versus Endarterectomy for Treatment of Carotid-Artery Stenosis

Thomas G. Brott, M.D., Robert W. Hobson, II, M.D.,* George Howard, Dr.P.H., Gary S. Roubin, M.D., Ph.D., Wayne M. Clark, M.D., William Brooks, M.D., Ariane Mackey, M.D., Michael D. Hill, M.D., Pierre P. Leimgruber, M.D., Alice J. Sheffet, Ph.D., Virginia J. Howard, Ph.D., Wesley S. Moore, M.D., Jenifer H. Voeks, Ph.D., L. Nelson Hopkins, M.D., Donald E. Cutlip, M.D., David J. Cohen, M.D., Jeffrey J. Popma, M.D., Robert D. Ferguson, M.D., Stanley N. Cohen, M.D., Joseph L. Blackshear, M.D., Frank L. Silver, M.D., J.P. Mohr, M.D., Brajesh K. Lal, M.D., and James F. Meschia, M.D., for the CREST Investigators†

N Engl J Med 2010 Jul 1;363(1):11-23. Epub 2010 May 26

CREST- Study Design
Carotid Revascularization Endarterectomy vs. Stenting Trial

- **Study population**
  - 2.502 patients, age mdn 69 y., male 75%
- **Inclusion**
  - asymptomatic Stenosis (n=1.181): ≥60%^{NASCET}, ≥70%^{Ultrasound}
  - symptomatic Stenosis (n=1.321): ≤180d, ≥50%^{NASCET}, ≥70%^{Ultrasound}
- **Tx**
  - CAS with Protection (one product only, Cordis) or CEA
- **Primary endpoint**
  - Safety: Stroke, MI, or death w/in 30d
  - Efficacy: Ipsilateral stroke up to 4y

Brott TG et al.: N Engl J Med (2010); 363(1): 11-23

CREST
long term efficacy (all patients), up to 4 years

Endpoint (ITT-Population)	CAS	CEA	HR (95%CI)	p-value
Stroke, MI, death 30 days + ipsilateral stroke 4y	7,2%	6,8%	1,11 (0,81-1,51)	0,51
Stroke or death 30 days + ipsilateral stroke 4y	6,4%	4,7%	1,50 (1,05-2,15)	**0,03**
Ipsilateral stroke 4y	10,2%	7,9%	1,40 (1,04-1,89)	**0,03**

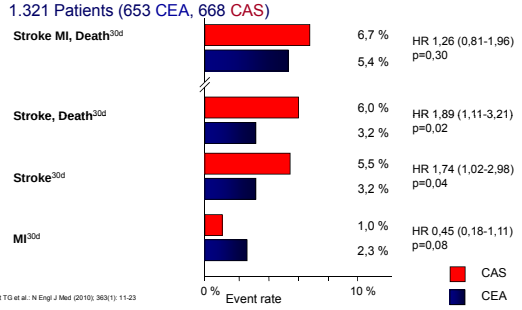
Brott TG et al.: N Engl J Med (2010); 363(1): 11-23

CREST
Safety, symptomatic patients only, 30 days

Endpoint (ITT-Population)	CAS	CEA	HR (95%CI)	p-Wert
Stroke, Mi, death	6,7%	5,4%	1,26 (0,81-1,96)	0,30
Stroke or death	6,0%	3,2%	1,89 (1,11-3,21)	**0,02**
Stroke	5,5%	3,2%	1,74 (1,02-2,98)	**0,04**
MI*	1,0%	2,3%	0,45 (0,18-1,11)	0,08

CREST Periprocedural Risk (Symptomatic Cohort)

1.321 Patients (653 CEA, 668 CAS)



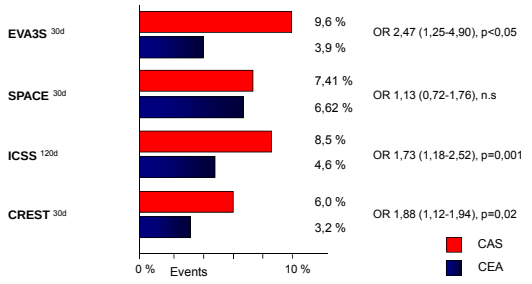
Brott TG et al.: N Engl J Med (2010); 363(1): 11-23

CREST Criticism

- Combining symptomatic and asymptomatic
- Combining endpoint elements of different importance
- Superiority design
- One company, and potential bias

Periprocedural Risk all large RCTs (ITT)

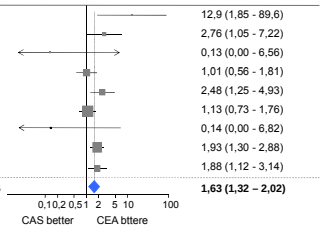
Endpoint: Stroke and Death



Update

CAS/CEA Metaanalysis (symptomatic)
Endpoint: Stroke and Death

Studie	CAS n / N	Surgery n / N	Peto odds ratio (95% Konfidenzinterval)
Leicester	5 / 11	0 / 12	12,9 (1,85 - 89,6)
Wallstent	13 / 107	5 / 112	2,76 (1,05 - 7,22)
Kentucky 2001	0 / 53	1 / 51	0,13 (0,00 - 6,56)
CAVATAS	25 / 251	25 / 253	1,01 (0,56 - 1,81)
EVA3S	25 / 261	10 / 259	2,48 (1,25 - 4,93)
SPACE	45 / 607	39 / 589	1,13 (0,73 - 1,76)
BACASS	0 / 10	1 / 10	0,14 (0,00 - 6,82)
ICSS	68 / 853	36 / 857	1,93 (1,30 - 2,88)
CREST	40 / 668	21 / 653	1,88 (1,12 - 3,14)
Total	**221 / 2821**	**138 / 2796**	**1,63 (1,32 – 2,02)**



p<0,0001 (Heterogeity I²=54%; p=0,04)

Odds-Ratio 1,63 (95%CI 1,32-2,02) in favour of Surgery

In Summary

- Surgery still gold standard
- Equivalence of stenting not finally established
- Meta-analysis significant for superiority of CEA, however significant heterogeneity
- Protection Devices certainly do not do what their name suggests
- Major effects by site and individuals
  - Under 70 probably equivalent, over 70 CEA much safer
- The final question is:
  - how good is the surgeon
  - and how good is the interventionalist

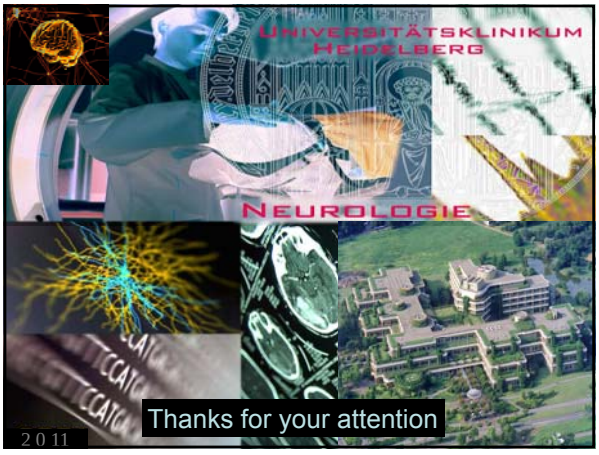
Conclusions

- At present, RCTs in patients with symptomatic carotid disease show inferior results of CAS compared to CEA with regard to the risk of stroke or death within 30 days of treatment.
- The safety of carotid stenting needs to be improved and subgroups of patients who could benefit from CAS need to be identified.
- Pending results from ongoing trials and combined analysis, carotid endarterectomy remains the treatment of choice of patients with symptomatic severe carotid stenosis.

A Final, Very Personal Statement

- What we currently see happen in clinical practice in Europe and the US is not acceptable
  - Asymptomatic patients are persuaded to stenting by cardiologists and radiologists, who claim superiority and low risk
  - They even ask for halting unethical RCTs, and do not take notice of the results
  - It is all about money- they charge for treatment of peripheral vessels
  - Complications are transferred and excluded from the registries

money, no science



Organisation of Stroke Services

Marrakesh WCN 2011

Stephen Davis
RMH Stroke Centre
Department of Neurosciences
Royal Melbourne Hospital
University of Melbourne

Stroke – a massive global problem

- Stroke is the most frequent major neurological disease - 20 million/year
- 2nd commonest cause of death worldwide
- Higher mortality than most forms of cancer – 10% within the first months
- High rate of long-term disability
- Increasing incidence and prevalence

RMH Comprehensive Stroke Centre

Why are early recognition and diagnosis time-critical?

- Both ischemic stroke and hemorrhagic stroke are dynamic, evolving conditions
- Stroke evolution results in increased lesion volume = worse outcome
- **Therapies for both ischemic stroke and ICH are aimed at limiting stroke growth**

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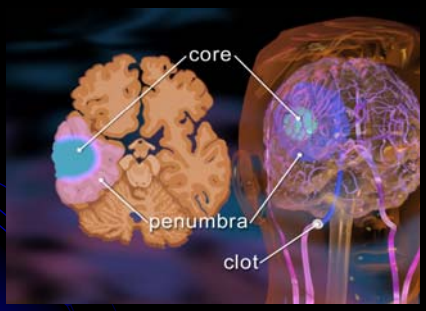
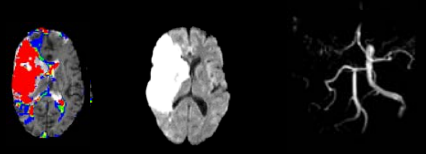
Rescuing the penumbra: the aim of acute stroke treatment

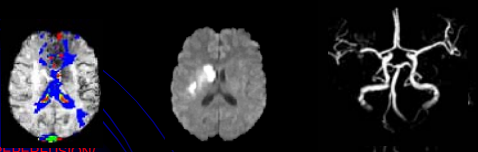


DAY 3-5



NO REPERFUSION/
RECANALIZATION → GROWTH

DAY 3-5



REPERFUSION/
RECANALIZATION → ATTENUATED GROWTH

Time is brain – Quantified

Saver J. Stroke 2006;37:263-266

Estimated Pace of Neural Circuitry Loss in Typical Large Vessel, Supratentorial Acute Ischemic Stroke

	Neurons Lost	Synapses Lost	Myelinated Fibers Lost	Accelerated Aging
Per Stroke	1.2 billion	8.3 trillion	7140 km/4470 miles	36 y
Per Hour	120 million	830 billion	714 km/447 miles	3.6 y
Per Minute	1.9 million	14 billion	12 km/7.5 miles	3.1 wk
Per Second	32 000	230 million	200 meters/218 yards	8.7 h

Every minute counts!

Chain of Recovery

Kennedy et al. Current Neurology and Neuroscience Reports, 2004

- **Recognition**
  - Public education
- **Reaction**
  - Speedy ambulance delivery to emergency department
- **Response**
  - Rapid ED teamwork to assess patient; code stroke
- **Reveal**
  - Urgent CT
- **Rx (treatment)**
  - Stroke unit care, tPA, aspirin, new emerging therapies
- **Rehabilitation**
  - Should start immediately in stroke care unit

Cincinnati Prehospital Stroke Scale

Facial Droop: Have Patient Smile

Image Source: NINDS

Arm Drift: Close Eyes & Hold Out Both Arms

Image Source: NINDS

Time is brain
Rapid transport to a stroke centre

- Rapid ambulance transport
- Paramedical diagnostic stroke tools
  - FAST,Cincinatti,LAPS
- Pre-hospital notification valuable
- Potential for ambulance-based therapy
  - Phase 3 in USA using magnesium sulphate

Conditions that mimic stroke

Hand et al. Stroke 2006

Condition	Total Number (%)[†]	Mimics presenting: Within 6 hrs[‡]	Mimics presenting: After 6 hrs[‡]
Seizure	23 (21.1%)	18 (29.0%)	5 (10.6%)
Sepsis	14 (12.8%)	6 (9.7%)	8 (17.0%)
Toxic / metabolic	12 (11.0%)	6 (9.7%)	6 (12.8%)
Space occupying lesion[§]	10 (9.2%)	3 (4.8%)	7 (14.9%)
Syncope / presyncope	10 (9.2%)	9 (14.5%)	1 (2.1%)
Acute confusional state	7 (6.4%)	3 (4.8%)	4 (8.5%)
Vestibular dysfunction	7 (6.4%)	3 (4.8%)	4 (8.5%)
Acute mononeuropathy	6 (5.5%)	4 (6.5%)	2 (4.3%)
Functional/medically unexplained symptoms	6 (5.5%)	4 (6.5%)	2 (4.3%)
Dementia	4 (3.7%)	2 (3.2%)	2 (4.3%)
Migraine	3 (2.8%)	2 (3.2%)	2 (4.3%)
Spinal cord lesion[¶]	3 (2.8%)	- (0%)	3 (6.4%)
Other[?]	3 (3.7%)	2 (3.2%)	1 (2.1%)
Total	**109 (100%)**	**62 (100%)**	**47 (100%)**

Clinical features that distinguish between stroke & mimic (Hand et al 2006)

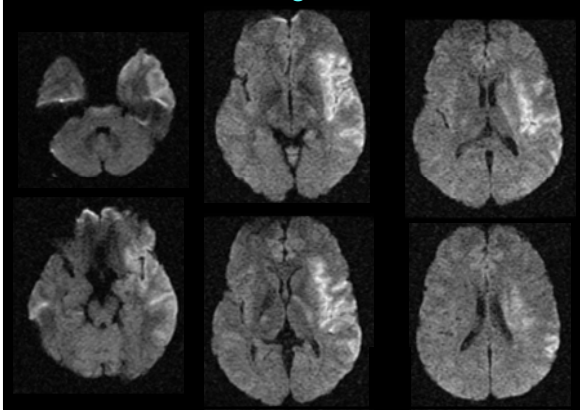
- **Stroke predicted by**
  - exact time of onset
  - patient could recall exactly what they were doing at symptom onset
  - well in the last week
  - definite focal symptoms or signs, worse NIHSS
- **Mimic predicted if**
  - known cognitive impairment
  - lost consciousness or seizure at onset
  - patient could still walk
  - no lateralising symptoms
  - confusion, non-vascular or no neurological signs

CT still the workhorse

R MCA Infarct 4.5 hours
early ischemic changes on CT

RMH Comprehensive Stroke Centre

MRI better for diagnosis acute ischemia



Acute interventions based on level I evidence

INTERVENTION	INITIAL OR IMPORTANT STUDY, YEAR	RRR	ARR (%)	NNT
Stroke unit	Langhorne et al, 1993	6.5	3.8	26
tPA	NINDS 1995;ECASS 3 2008	9.8	5.5	7
Aspirin	IST, CAST 1997	2.6	1·2	83
Hemicraniectomy	Vahedi K et al, 2007	48.8	23.0	4

GA Donnan, M Fisher, M Macleod SM Davis Lancet, 2008.

RMH Comprehensive Stroke Centre

Emergency Department – Code Stroke

1. Urgent triage and high priority for stroke patient
2. Mobilise the stroke team with joint pager
3. IV - glucose, routine biochemistry, FBE
4. ECG
5. Accurate clinical diagnosis – exclude mimics
6. Urgent CT
7. Rapid transit and aim to use tPA if eligible

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Code Stroke

- Instant notification of stroke team for patients < 9 hours by triage nurse/ED doctor linked paging system (resident, fellow, nurse consultant) 24/7
- Decreases DTN (142 mins to 62 mins)
- Thrombolysis rate up to 20%

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Recent ASA initiative "Target: Stroke"

Strategy	Best Practice	Explanation
01	Advance hospital notification by EMS	EMS providers should, if feasible, provide early notification to the receiving hospital when stroke is recognized in the field. Advance notification of patient arrival by EMS can shorten time to CT and improve the timeliness of treatment with thrombolysis.
02	Rapid triage protocol and stroke team notification	Acute triage protocols facilitate the timely recognition of stroke and reduce time to treatment. Acute stroke teams enhance stroke care and should be activated as soon as the stroke patient is identified in the emergency department or after notification from pre-hospital personnel.
03	Single-call activation system	A single-call should activate the entire stroke team. A single-call activation system for the stroke team is defined here as a system in which the emergency department calls a central page operator, who then simultaneously pages the entire stroke team, including notification for stroke protocol imaging.
04	Stroke tools	A stroke toolkit containing clinical decision support, stroke-specific order sets, guidelines, hospital-specific algorithms, critical pathways, NIH Stroke Scale, and other stroke tools should be available and used for each patient.
05	Rapid acquisition and interpretation of brain imaging	It is essential to initiate a CT scan (or MRI) within 25 min of arrival and complete interpretation of the CT scan within 45 min of arrival to exclude intracranial hemorrhage prior to administration of intravenous tPA.
06	Rapid laboratory testing (including point-of-care testing if indicated)	When indicated, laboratories such as platelet count and—for patients in whom coagulation parameters should be assessed due to suspicion of coagulopathy—INR/PT/PTT results should be available as quickly as possible and no later than 45 min after ED arrival. If standard stat laboratory turnaround times cannot meet this target, point-of care testing in the emergency department can provide the data in the needed timeframe.

Fonarow et al. Stroke 2011;42:2983-9.

Recent ASA initiative "Target: Stroke"

...continued

07	Mix tPA medication ahead of time	Mix drug and set up the bolus dose and 1-hour infusion pump as soon as a patient is recognized as a possible tPA candidate, even before brain imaging. Early preparation allows tPA infusion to begin as soon as the medical decision to treat is made. It is the policy of some drug manufacturers to replace, free of charge, medications that are mixed but not used in time-critical emergency situations such as these. Check with your hospital pharmacy for the proper procedures that will allow you to use this strategy to shorten time to treatment without financial risk.
08	Rapid access to intravenous tPA:	Once eligibility has been determined and intracranial hemorrhage has been excluded, intravenous tPA should be promptly administered. tPA should be readily available in the emergency department or CT scanner area (if CT scanner is not located in the ED). Dosing charts and standardized order sets can also facilitate timely administration and minimize dosing errors.
09	Team-based approach	The team approach based on standardized stroke pathways and protocols has proven to be effective in increasing the number of eligible patients treated and reducing time to treatment in stroke. An interdisciplinary collaborative team is also essential for successful stroke performance improvement efforts. The team should meet frequently to review your hospital's processes, care quality, patient safety parameters and clinical outcomes, as well as to make recommendations for improvement.
10	Prompt data feedback	Accurately measuring and tracking your hospital's door-to-needle times, IV tPA treatment rates in eligible patients and performance on other stroke performance/quality measures equip the stroke team to identify areas for improvement and take appropriate action. A data-monitoring and feedback system includes using the Get With The Guidelines-Stroke Patient Management Tool (PMT) and creating a process for providing timely feedback on a case-by-case basis and in hospital aggregate. This system helps identify specific delays, set targets and monitor progress on a case-by-case basis.

Fonarow et al. Stroke 2011;42:2983-9.

Twelve measures to reduce DNT in Helsinki

Measure	Description	Year
EMS involvement	Education of dispatchers and EMS personnel, stroke high priority dispatch.	1998
Hospital pre-notification	EMS contacts stroke physician directly via mobile phone.	2001
Alarm and pre-order of tests	Lab and CT computer-ordered and alarmed at pre-notification.	2001
Pre-acquisition of history	State-wide electronic patient records and eye-witness interview during transportation.	2005
CT relocated to ER	Patient transfers of several hundred meters, including elevators, were no longer needed.	2003
CT priority and CT transfer	CT emptied prior to patient arrival, patient transferred straight onto CT table, not ER bed.	2004
Rapid neurological evaluation	Patient is examined upon arrival, on CT table.	2004
Point-of-care INR	Lab personnel draw blood while patient on CT table, and perform instant POC INR.	2005
No-delay CT interpretation	Stroke physician interprets the CT scan, rarely consulting neuroradiologists.	2001
Reduced imaging	Advanced imaging reserved for unclear cases only.	2005
Pre-mixing of tPA	With highly suspect thrombolysis candidates, tPA pre-mixed prior to patient arrival.	2002
Delivery of tPA on CT table	Bolus administered on CT table.	2002

Meretoja A, Strbian D, Mustanoja S, Tatlisumak T, Lindsberg PJ, Kaste M. Submitted. Slide courtesy of Dr. Meretoja.

All strokes (ischemic or hemorrhagic): admit to a stroke unit

Stroke Care Units

The key components

No age or severity barriers to the benefit

Assessment and monitoring	
Medical	Systematic clinical history and examination Routine investigations—serum biochemistry, haematology, electrocardiogram, CT Investigations in selected patients—carotid doppler, echocardiogram, MRI
Nursing	General care needs, vital signs, swallow assessment, fluid balance, pressure-area risks, neurological monitoring
Therapy	Assessment of impairments and function
Early management	
Physiological management	Careful management of food and fluids (often intravenous saline over first 12–24 h) Monitoring and treatment of infection, pyrexia, hypoxia, hyperglycaemia
Early mobilisation	Early measures to get patient sitting up, standing, and walking
Nursing care	Careful positioning and handling, and pressure-area care Management of swallowing problems Avoidance of urinary catheters if possible
Multidisciplinary team rehabilitation	
Rehabilitation process	Formal multidisciplinary meetings once a week (plus informal meetings) Early rehabilitation, goal-setting, and involvement of carers Close linking of nursing with other multidisciplinary care Provision of information on stroke, recovery, and services
Discharge planning	Early assessment of discharge needs Discharge plan involving patient and carers

Stroke Centres

- Primary
  - ED
  - Geographical stroke unit, multidisciplinary team
  - 24 hour CT
  - Use tPA
- Comprehensive stroke centres
  - Multimodal imaging MRI, CTP
  - Neurointervention
  - Neurosurgery and vascular surgery
  - Active research program
  - Often telestroke provider

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Assessment and Minimisation of Complications

- Hypoxia reduction
- Glycaemia control
- Dehydration prevention
- Neurological & vital sign monitoring
- Chest infection risk reduction
- Deep venous thrombosis minimisation
- Pressure risk management
- Shoulder injury prevention
- Continence assessment

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Why are Stroke Units effective?

- Focused attention on stroke care including:
  - Prevention and early detection / treatment of complications of stroke
  - Prevention of early stroke recurrence by attention to stroke risk factors / secondary prevention strategies
  - Early rehabilitation

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THE COCHRANE COLLABORATION®

Organised inpatient (stroke unit) care for stroke (Review)

Reviewers' conclusions

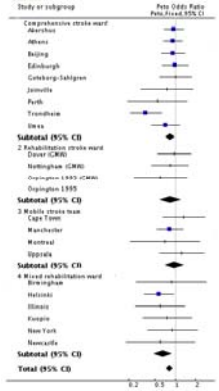
Stroke patients who receive organised inpatient care in a stroke unit are more likely to be alive, independent, and living at home one year after the stroke. The benefits were most apparent in units based in a discrete ward. No systematic increase was observed in the length of inpatient stay.

SYNOPSIS

Patients who receive organised stroke unit care are more likely to survive their stroke, return home and make a good recovery.

Organised stroke unit care is a form of care provided in hospital by nurses, doctors and therapists who specialise in looking after stroke patients and work as a coordinated team. Patients who receive this care are more likely to survive their stroke, return home and become independent in looking after themselves. A variety of different types of stroke unit has been developed. The best results seem to come from those which are based in a dedicated ward.

Organised inpatient stroke unit care



Highly significant 18% reduction in odds of poor outcome
p = 0.001

For every 1000 patients admitted to an organised stroke unit,
43 avoid being
'dead or dependent' at 1 year

Stroke Unit Trialists' Collaboration. Cochrane Database of Systematic Reviews

Odds of death

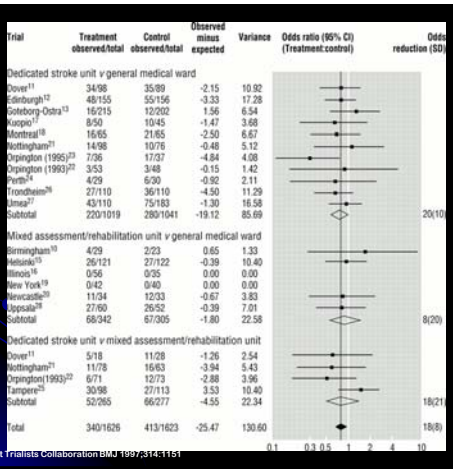


Fig 1 Stroke Unit Trialists Collaboration BMJ 1997;314:1151

Odds of death or institutional care

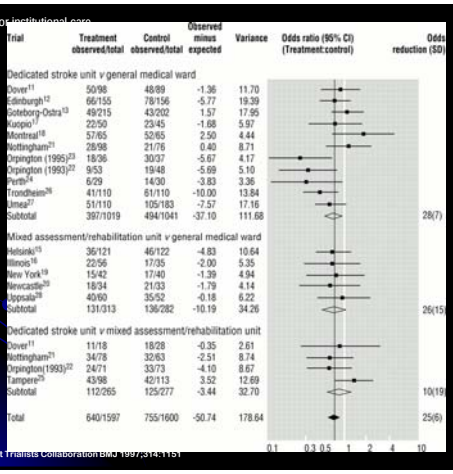


Fig 2 Stroke Unit Trialists Collaboration BMJ 1997;314:1151

Odds of death or dependency

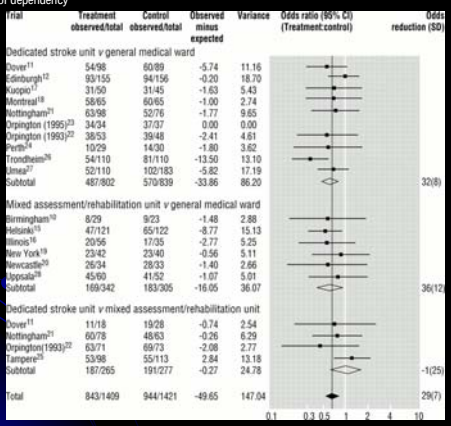


Fig 3 Stroke Unit Trialists Collaboration BMJ 1997;314:1151

TABLE 4. Length of Hospital Stay and Outcome in Patients Treated at the Stroke Unit and Patients Treated on General Wards

	General Wards	Stroke Unit	P
LOHS, d	55.2 (47.1-63.4)	38.6 (35.7-41.6)	<.0001
LOHS,* d	38.5 (32.2-44.9)	29.6 (27.1-32.0)	.002
LOHS,† d	55.5 (39.4-71.7)	33.5 (28.1-38.9)	.001
LOHS,‡ d	55.1 (45.6-64.6)	40.8 (37.2-44.3)	.0007
Discharged to home	171 (56)	607 (65)	.02
Discharged to nursing home	45 (15)	115 (12)	.02
Died during hospital stay	89 (29)	214 (23)	.02
Case-fatality rate (30 d)	69 (23)	161 (17)	.03
6-mo mortality	106 (35)	258 (28)	.01
1-y mortality	120 (39)	300 (32)	.01

LOHS indicates length of hospital stay. Continuous data are expressed as mean (95% confidence interval). Categorical data are expressed as number of patients (%).
*Excluding patients discharged to nursing home.
†Patients aged ≤70 y.
‡Patients aged >70 y.

Jorgensen et al Stroke 1995;26:1178-1182.

TABLE 5. Relative Risk of Death, Discharge to Nursing Home, and Discharge to Home After Treatment on the Stroke Unit vs Treatment on General Wards, Independent of Other Influencing Factors

	Relative Risk*	95% CI	P	R
In-hospital mortality	0.50	0.34 to 0.74	<.001	−.12
Case-fatality rate (30 d)	0.45	0.28 to 0.71	<.001	−.12
6-mo mortality	0.57	0.39 to 0.82	.002	−.08
1-y mortality	0.59	0.42 to 0.84	.003	−.08
Discharge to nursing home	0.61	0.38 to 0.98	.04	−.10
Discharge to home	1.90	1.30 to 2.70	<.001	.09

CI indicates confidence interval.
*Relative risk (odds ratio) in patients treated on the stroke unit compared with patients treated on general wards.

Jorgensen et al Stroke 1995;26:1178-1182.

Number of stroke patients you need to treat in a stroke unit

To prevent one death:

NNT= 22

To prevent one admission to institutional care:

NNT= 14

To prevent one loss of independence:

NNT= 16

Stroke Unit Trialists' Collaboration BMJ 1997;314:1151

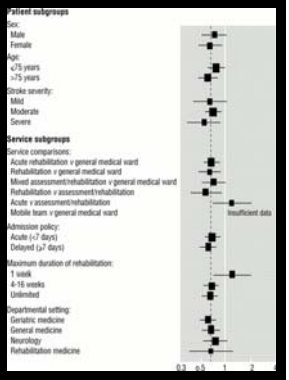
Who benefits from SCU?

Almost everyone!

- gender, age, severity
- All types of SCU that provide care lasting >1 week

Benefit most apparent in units based in a discrete ward

- *Not mobile teams*



Cochrane Library, 2003

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The SCU: the most important intervention for acute stroke

Actual and potential benefits (avoidance of death or disability) of acute interventions for stroke in Australia

Intervention	Absolute risk reduction	Number needed to treat	Estimated proportion of stroke patients treated*	Current absolute benefit† (number of cases)	Potential proportion of stroke patients treated	Potential absolute benefit† (number of cases)
Stroke care unit	4%‡	25‡	23%	423	80%	1472
Aspirin§	1.2%‖	83§	70%	387	80%	443
Tissue plasminogen activator¶	12.0%¶	8¶	< 1%	< 23	10%	575

* From the National Stroke Foundation survey of stroke care unit access, 1998.[16]
† Number of deaths or cases of disability avoided among 46 000 strokes in Australia per year.
‡ From the Stroke Unit Trialists' Collaboration.[17] § From the International Stroke Trial.[11]
¶ From the National Institute of Neurological Disorders and Stroke recombinant tissue plasminogen activator trial.[10]

MJA, 2003

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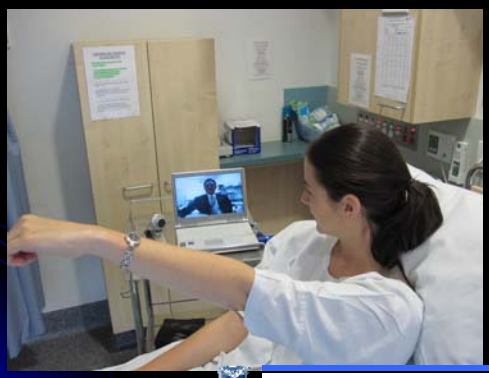
RMH Telestroke Service



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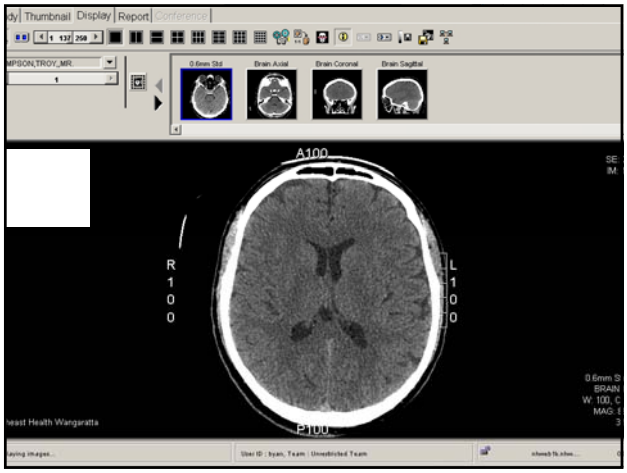

Thrombolysis via Telestroke

Schwab et al; Neurology 2007; 69: 898-903

- TEMPIS – Telemedicine Pilot Project for Integrative Stroke Care in Bavaria
- Assessed tPA results in telemedicine vs stroke centre hopsitals
- 170 telemedicine, 132 stroke centres
- Mortality and functional outcome after tPA similar

Take home messages

Stroke Care Units

- Reduce mortality
- Reduce dependency
- Improve efficiency – reduce LOS
- Facilitate scientific research and health systems research
- Facilitate networking
- Teamwork - morale

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AOCN 2012 in Melbourne

"The World's Most Liveable City 2011"