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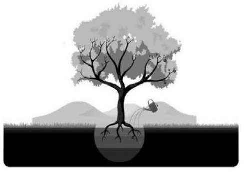
일년차가 알아야 할 Stroke

The Bare minimum of Stroke:



Sang-Bae Ko, MD, PhD

Division of Critical Care Neurology and Stroke

Seoul National University Hospital

M/75, HT, DM
Sudden left side weakness

LNT: 4h ago,
FAT: 3h 30min

Dysarthria, motor Gr III
Hemineglect

NIHSS 몇점인가?

www.stroke-edu.or.kr

Integrated Acute Stroke Flowsheet

National Institutes of Health Stroke Scale

Complete a full assessment TID during the first 72 hours after admission for stroke, with any decline in neurological status, and when the patient is received from ER, ICU, or PACU into 6NW or 6 Observation. After the 72 hour period, a full assessment should be completed with any changes in neurological status, and prior to discharge.
Complete a modified assessment (the shaded sections, and any other area of concern) when the neurological assessment is required more often than TID.
Administer NIHSS in order listed. Record performance in each category after each subscale exam. Do not go back and change scores. Scores should reflect what the patient does, and not what the clinician thinks the patient can do. Except where indicated, the patient should not be coached (i.e. repeated requests to patient to make a special effort).

CATEGORY	Description	Score	Date/Time	Date/Time	Date/Time	Date/Time
1a. Level of consciousness ***(Patients who score 2 or 3 on this item, should be assessed using the Glasgow Coma Scale)	Alert, keenly responsive Not alert (arousable by minor stimulation to obey, answer, or respond) Not alert (responds to repeated or painful stimulation) Only reflex motor, autonomic effects, or totally unresponsive	0 1 2 3				
1b. LOC, questions (month, age)	Answers both questions correctly Answers one question correctly Answers neither question correctly	0 1 2				
1c. LOC, commands (Open/close eyes, make fist, release fist) Pantomime may be used	Performs both tasks correctly Performs one task correctly Performs neither task correctly	0 1 2				
2. Best gaze (Patient follows examiner's finger or face through full horizontal field)	Normal Partial gaze palsy Forced deviation (deviation not overcome by oculocephalic maneuver)	0 1 2				
3. Visual (Introduce visual stimulus/threat to patient's field quadrants)	No visual loss Partial hemianopia (sector or quadrant field deficit) Complete hemianopia (dense field loss, such as half of visual field) Bilateral hemianopia (blind)	0 1 2 3				
4. Facial palsy (Show teeth, raise eyebrows, squeeze eyes shut) Pantomime may be used	Normal Minor paralysis (mild asymmetry on smiling) Partial paralysis (paralysis of lower face) Complete (one or both sides: paralysis of upper and lower face)	0 1 2 3				
5a. Motor arm - Left (Test each limb independently: Palm Down: Elevate arm to 90° if pt sitting, 45° if pt supine and score drift/movement over 10 seconds)	No drift (limb holds for full 10 seconds) Drift (limb drifts downward but does not fall to rest on a support) Some effort against gravity (drifts to fall on support) No effort against gravity (trace movement, limb falls immediately) No voluntary movement Amputation, Joint fusion etc	0 1 2 3 4 X				
5b. Motor arm – Right (As above)						
6a. Motor leg - Left (Test each limb independently. With pt supine, elevate extremity to 30° and score drift/movement over 5 seconds)	No drift (limb holds for full 5 seconds) Drift (limb drifts downward but does not fall to rest on a support) Some effort against gravity (drifts to fall on support) No effort against gravity (trace movement, limb falls immediately) No voluntary movement Amputation, Joint fusion etc	0 1 2 3 4 X				
6b. Motor leg - Right (As above)						
7. Limb ataxia (Finger-nose, heel down shin)	Absent Present in one limb Present in two limbs	0 1 2				
8. Sensory (Pin prick to face, arm, trunk, and leg – compare side to side) Look at grimace in aphasic patient	Normal Mild to moderate sensory loss (less sharp/dullness) Severe or total sensory loss (not aware of touch)	0 1 2				
9. Best language (Name item, describe a picture and read sentences)	No aphasia Mild to moderate aphasia (reduced fluency or comprehension) Severe aphasia (communication exchange very limited) Mute, global aphasia	0 1 2 3				
10. Dysarthria (Evaluate speech clarity by having patient read or repeat listed words)	Normal articulation Mild to moderate dysarthria (can be understood) Severe dysarthria (unintelligible or worse) Intubated or other physical barrier	0 1 2 X				
11. Extinction and Inattention (Use information from prior testing to identify neglect or double simultaneous stimuli testing)	No abnormality (no neglect) Visual, tactile, auditory, spatial, or personal inattention, or extinction to bilateral stimulation in one of the sensory modalities) Profound: more than one modality affected	0 1 2				
*Please Note: the pupil chart is to be used as an example only and may change with replication.		TOTAL SCORE				
PUPILS* Sizes: 1mm 2mm 3mm 4mm 5mm 6mm 7mm 8mm 9mm Reaction: + normal S sluggish - absent		Left Size/Reaction				
		Right Size/Reaction				
Signature on back side of page.		Initials of examiner				

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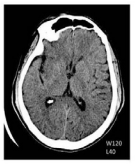
NIHSS 6, R/o Acute stroke R/o Rt. MCA infarction

Q1. ER 에서 시행할 Initial Lab 중 우선 순서에서 가장 나중인 것은?

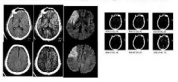
1) CBC
2) Glucose
3) Coagulation panel
4) CPA
5) EKG

Q2. Imaging modality of choice? CT



Early ischemic signs
1) Gray-white loss of differentiation
2) BG low density
3) Insular ribbon sign

For better sensitivity, change W40/L40



ER w/u: thrombolysis

Coagulation panel / PT INR1.7, aPTT
CBC: platelet count : 100K
Stroke mimicking condition
Hypoglycemia : glucose 50mg/dL
Initial heart evaluation: EKG, troponin
Af detection
Concomitant MI
CPA : optional
no change in clincial decision process

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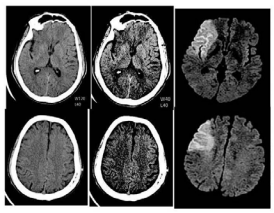
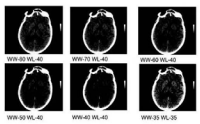
Early ischemic signs

1) Gray-white loss of differentiation
2) BG low density
3) Insular ribbon sign

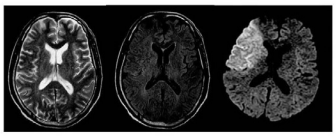
For better sensitivity, change W40/L40

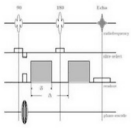


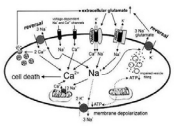


Brain MR

More sensitive to ischemia compared to CT

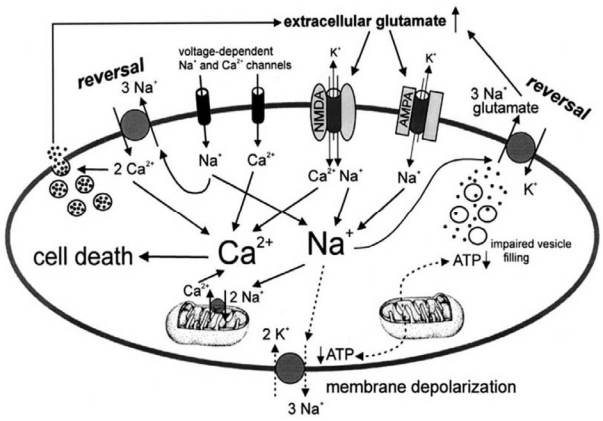






Water molecule Brownian movement

Ischemia -> cytotoxic edema ->
intracellular water increase
-> low degree of Free water movement



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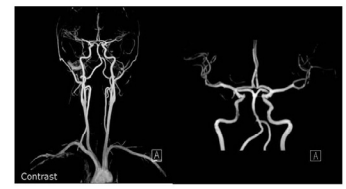
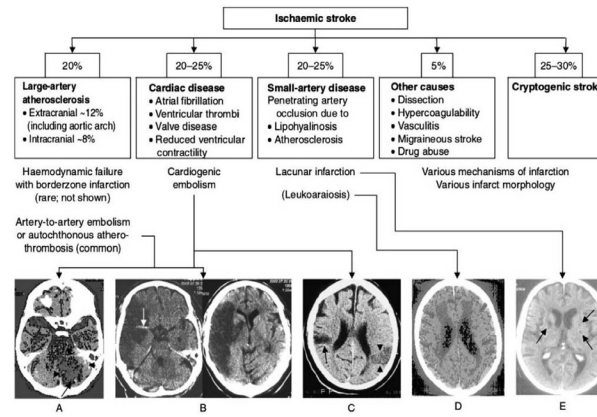
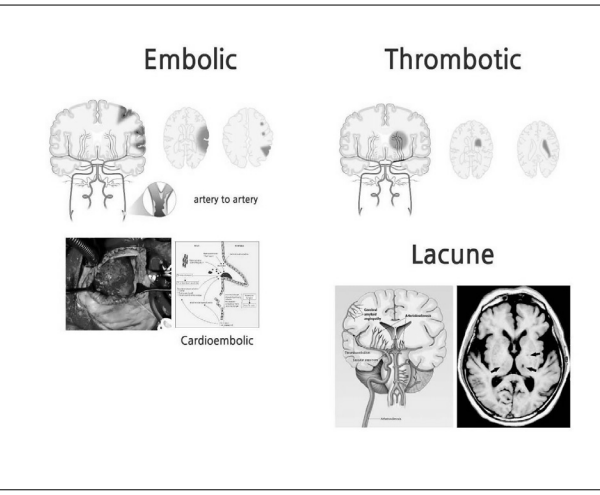
MRA



Parenchymal imaging + Vessel imaging
-> stroke mechanism





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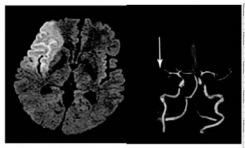
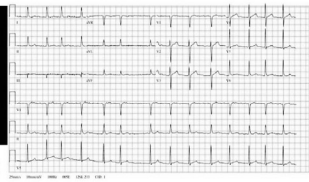
Our patient, M/75, LNT 4h





Alleged CE Rt. MCA infarction

Q3. What is your next step?

1) Aspirin 300mg 투약
2) Vessel 이 막혔으므로 tPA 는 시간관계없이 사용
3) Vessel 이 막혀서 IA thrombolysis
4) 영상소견 관계없이 tPA candidate
5) Hemicraniectomy 수술

TISSUE PLASMINOGEN ACTIVATOR FOR ACUTE ISCHEMIC STROKE

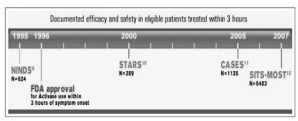
THE NATIONAL INSTITUTE OF NEUROLOGICAL DISORDERS AND STROKE rt-PA STROKE STUDY GROUP*

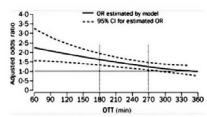
Assessment Instrument	Percentage with Favorable Outcome†		Odds Ratio (95% CI)‡	Relative Risk (95% CI)‡	P Value
	tPA	Placebo			
Part 2, 0–180 min§					
No. of patients	168	165			
Global test	—	—	1.7 (1.2–2.6)	—	0.008
Barthel index	50	38	1.9 (1.1–3.3)	1.3 (1.0–1.7)	0.026
Modified Rankin scale	39	26	1.7 (1.1–2.6)	1.5 (1.1–2.0)	0.019
Glasgow outcome scale	44	32	1.8 (1.1–2.5)	1.4 (1.0–1.8)	0.025
NIHSS	31	20	1.7 (1.0–2.8)	1.5 (1.0–2.2)	0.033
Part 1, 0–180 min§					
No. of patients	144	147			
Global test	—	—	2.1 (1.5–3.2)	—	0.001
Barthel index	54	39	1.8 (1.1–2.8)	1.4 (1.1–1.8)	0.012
Modified Rankin scale	47	27	2.3 (1.4–3.6)	1.7 (1.3–2.3)	<0.001
Glasgow outcome scale	47	31	2.0 (1.2–3.1)	1.5 (1.1–2.0)	0.005
NIHSS	38	21	2.2 (1.3–3.7)	1.8 (1.2–2.6)	0.002

Table 6. Incidence of Intracranial Hemorrhage within 36 Hours of Treatment for Stroke.

Type of Intracranial Hemorrhage	tPA	Placebo
	no. (%)	
Part 1	144	147
Symptomatic	8 (6)	0
Fatal*	4	0
Nonfatal	4	0
Asymptomatic	5 (3)	3 (2)
Part 2	168	165
Symptomatic	12 (7)	2 (1)
Fatal	5	1
Nonfatal	7	1
Asymptomatic	9 (5)	6 (4)

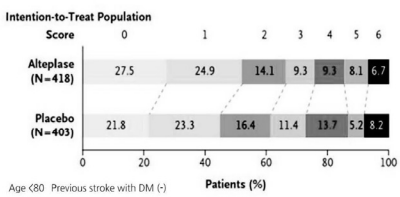
Age limitation (-)





Thrombolysis with Alteplase 3 to 4.5 Hours after Acute Ischemic Stroke

N Engl J Med 2008;359:1317-29.



Age <80 Previous stroke with DM (-)

	Day 90			
	Intention-to-Treat Population		Per-Protocol Population	
	odds ratio (95% CI)	*P value*	*odds ratio (95% CI)*	*P value*
mRS score of 0 or 1†	1.34 (1.02–1.76)	0.04	1.47 (1.10–1.97)	0.001
mRS score of 0–2	1.30 (0.95–1.78)	0.11	1.41 (1.01–1.96)	0.04
Barthel Index score ≥95‡	1.23 (0.93–1.62)	0.15	1.33 (0.99–1.80)	0.06
NIHSS score of 0 or 1, or >8-point improvement from baseline§	—		—	

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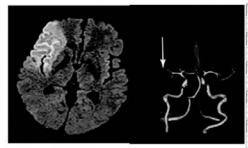
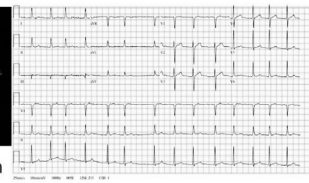
	3h	4.5h
Age <80	O	O
Age >80	O	X

2014.1 부터가능

비보험

Our patient, M/75, LNT 4h





Alleged CE Rt. MCA infarction

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2) Vessel 이 막혔으므로 tPA 는 시간관계없이 사용
3) Vessel 이 막혀서 IA thrombolysis
4) 영상소견 관계없이 tPA candidate
5) Hemicraniectomy 수술

tPA 0.9mg/kg BP: 195/100 mmHg

Q4. What to do?

1) Never give tPA
2) Wait until BP drops then give tPA
3) Give antihypertensive then give tPA
4) Give tPA regardless of BP

tPA 사용이 아닐경우, 220/120 mmHg 까지는 BP 조절 하지 않음

After tPA administration, NIHSS improved to 2
left side motor: arm 1, leg 1

Q5. What should we do?

A) Admission to ICU
B) minor stroke, admission to General ward
C) admission to Stroke unit
D) Discharge the patient

사망률

Review: Organised inpatient (stroke unit) care for stroke
Comparison: 1 Organised stroke unit care versus alternative service
Outcome: 1 Death by the end of scheduled follow-up

Study or subgroup	Treatment n/N	Control n/N	Peto Odds Ratio Peto,Fixed,95% CI	Peto Odds Ratio Peto,Fixed,95% CI
1 Stroke ward versus general medical ward				
Athens 1995	103/302	127/302		0.71 [0.51, 0.99]
Beijing 2004	12/195	19/197		0.62 [0.30, 1.29]
Dover 1984 (GMW)	34/98	35/89		0.82 [0.45, 1.48]
Edinburgh 1980	48/155	55/156		0.82 [0.51, 1.32]
Goteborg-Ostra 1988	16/215	12/202		1.27 [0.59, 2.73]
Goteborg-Sahlgren 1994	45/166	19/83		1.25 [0.68, 2.27]
Guangdong 2009	2/100	5/100		0.41 [0.09, 1.86]
Huaihua 2004	10/324	10/73		0.11 [0.03, 0.35]
Joinville 2003	9/35	12/39		0.78 [0.29, 2.14]
Nottingham 1996 (GMW)	14/98	10/76		1.10 [0.46, 2.61]
Orpington 1993 (GMW)	3/53	6/48		0.43 [0.11, 1.70]
Orpington 1995	7/34	17/37		0.33 [0.12, 0.87]
Perth 1997	4/29	6/30		0.65 [0.17, 2.50]
Svendborg 1995	14/31	12/34		1.50 [0.56, 4.02]
Trondheim 1991	27/110	36/110		0.67 [0.37, 1.20]
Subtotal (95% CI)	**1945**	**1576**		**0.75 [0.63, 0.90]**
3 Mobile stroke team versus general medical ward				
Manchester 2003	45/157	35/151		1.33 [0.80, 2.21]
Montreal 1985	16/65	21/65		0.69 [0.32, 1.47]
Subtotal (95% CI)	**222**	**216**		**1.08 [0.71, 1.65]**

사망 혹은 중증도 장애율

Review: Organised inpatient (stroke unit) care for stroke
Comparison: 1 Organised stroke unit care versus alternative service
Outcome: 3 Death or dependency by the end of scheduled follow-up

Study or subgroup	Treatment n/N	Control n/N	Peto Odds Ratio Peto,Fixed,95% CI	Peto Odds Ratio Peto,Fixed,95% CI
1 Stroke ward versus general medical ward				
Athens 1995	138/302	145/302		0.91 [0.66, 1.25]
Beijing 2004	113/195	118/197		0.92 [0.62, 1.38]
Dover 1984 (GMW)	54/98	50/89		0.96 [0.54, 1.70]
Edinburgh 1980	93/155	94/156		0.99 [0.63, 1.56]
Goteborg-Sahlgren 1994	108/166	54/83		1.00 [0.58, 1.74]
Huaihua 2004	83/324	39/73		0.27 [0.16, 0.47]
Joinville 2003	18/35	23/39		0.74 [0.30, 1.84]
Nottingham 1996 (GMW)	63/98	52/76		0.83 [0.44, 1.56]
Orpington 1993 (GMW)	38/53	39/48		0.59 [0.24, 1.48]
Orpington 1995	34/34	37/37		0.0 [0.0, 0.0]
Perth 1997	10/29	15/30		0.54 [0.19, 1.49]
Trondheim 1991	54/110	81/110		0.36 [0.21, 0.61]
Subtotal (95% CI)	**1599**	**1240**		**0.75 [0.64, 0.88]**

Total events: 806 (Treatment), 747 (Control)
Heterogeneity: $Chi^2 = 26.73$, $df = 10$ ($P = 0.003$); $I^2 = 63\%$
Test for overall effect: $Z = 3.56$ ($P = 0.00037$)

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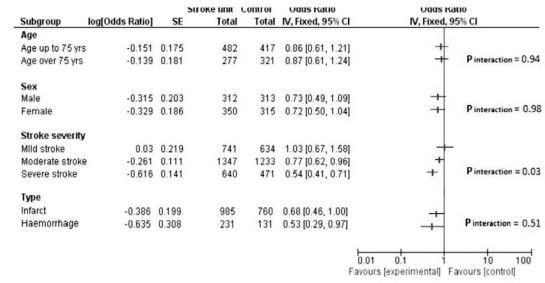
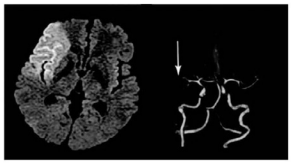
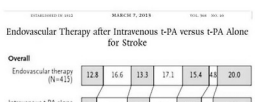


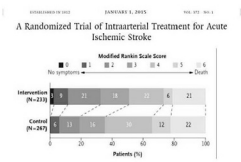


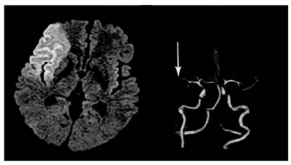
tPA -> no improvement

Q> Next step?

1) Wait and see
2) Sedate patient for neuroprotection
3) Give Aspirin
4) IA thrombectomy
5) Heparin







tPA -> no improvement

Q> Next step?

1) Wait and see
2) Sedate patient for neuroprotection
3) Give Aspirin
4) IA thrombectomy
5) Heparin

This patient was admitted to SU

Q6. Which is correct?

A) Liberalize BP medication, up to 220/120 mm Hg
B) Give Oxygen via nasal prong
C) strict glucose control below 120 mg/dL
D) Give Aspirin as soon as possible
E) Use N/S rather than D5W

To minimize the risk of hemorrhagic transformation

Strict BP control < 180/105

Glucose: 140 - 180 mg/dL

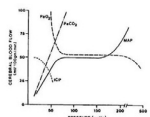
Routine Oxygen is not beneficial

high PaO2 -> decrease CBF

ASA treatment

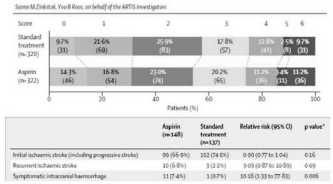
Main fluid

Glucose free



Early administration of aspirin in patients treated with alteplase for acute ischaemic stroke: a randomised controlled trial

Lancet 2012; 380: 731–37



	Aspirin (n=148)	Standard treatment (n=137)	Relative risk (95% CI)	p value*
Initial ischaemic stroke (including progressive stroke)	99 (66·9%)	102 (74·5%)	0·90 (0·77 to 1·04)	0·16
Recurrent ischaemic stroke	10 (6·8%)	3 (2·2%)	3·09 (0·87 to 10·93)	0·09
Symptomatic intracranial haemorrhage	11 (7·4%)	1 (0·7%)	10·18 (1·33 to 77·83)	0·006

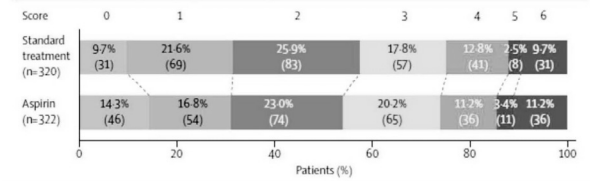
MEMO

MEMO

Early administration of aspirin in patients treated with alteplase for acute ischaemic stroke: a randomised controlled trial

Lancet 2012; 380: 731–37

Sanne M Zinkstok, Yvo B Roos, on behalf of the ARTIS investigators



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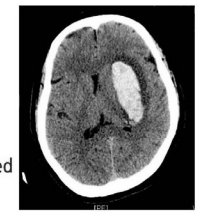
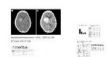
Recurrent ischaemic stroke	10 (6·8%)	3 (2·2%)	3·09 (0·87 to 10·89)	0·09
Symptomatic intracranial haemorrhage	11 (7·4%)	1 (0·7%)	10·18 (1·33 to 77·83)	0·006

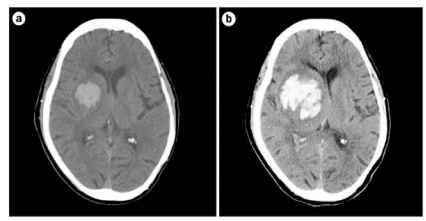
M/45 HT (+) for 10Y Sudden LOC, 1ha

Q6. What is your choice?

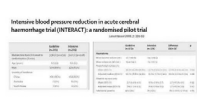
A) Call NS, and prepare surgery
B) Should not decrease BP
C) Elevate BP for better perfusion
D) Give prophylactic AED
E) Consider ICP lowering when indicated







hematoma expansion > 33%, 38% in 24h
BP plays lots of role



MEMO

Intensive blood pressure reduction in acute cerebral haemorrhage trial (INTERACT): a randomised pilot trial

Lancet Neurol 2008; 7: 391–99

	Guideline (n=201)	Intensive (n=203)
Median time from ICH onset to randomisation (h:min)	3:36 (2:54–4:54)	3:42 (2:54–4:48)
Age (years)	62 (13)	63 (12)
Male	139 (69%)	123 (61%)
Country of residence		
China	191 (95%)	193 (95%)
Australia	7 (3%)	6 (3%)
South Korea	3 (1%)	4 (2%)

	Guideline (n=172)	Intensive (n=174)	Difference (95% CI)*	p
Haematoma				
Mean baseline volume (mL)	12·7 (11·6)	14·2 (14·5)	..	..
Mean volume at 24 h (mL)	15·4 (14·7)	15·2 (17·5)	..	..
Proportional increase (%)				
Mean (95% CI)	36·3% (15·8 to 56·8%)	13·7% (5·9 to 21·5%)	22·6% (0·6 to 44·5%)	0·04
Adjusted median (95% CI)†	16·2% (8·8 to 24·1%)	6·2% (–0·7 to 13·4%)	10·0% (0·0 to 20·5%)	0·06
Absolute increase (mL)				
Mean (95% CI)	2·7 (1·4 to 4·0)	0·9 (–0·9 to 2·7)	1·7 (–0·5 to 4·0)	0·12
Adjusted mean (95% CI)	2·6 (1·1 to 4·2)	0·9 (–0·6 to 2·5)	1·7 (–0·5 to 3·9)	0·13
Substantial growth‡	40 (23%)	26 (15%)	8% (–1·0 to 17·0%)§	0·05

Rapid Blood-Pressure Lowering in Patients with Acute Intracerebral Hemorrhage

N Engl J Med 2013;368:2355-65.

Table 2. Treatment of Patients with Intracerebral Hemorrhage.

Variable	Intensive Blood-Pressure Lowering (N = 1399)	Guideline-Recommended Blood-Pressure Lowering (N = 1430)	P Value
Time from ICH to start of treatment — hr			<0.001
Median	4.0	4.5	
Interquartile range	2.9–5.1	3.0–7.0	

Table 3. Primary, Secondary, and Safety Outcomes at 90 Days.*

Variable	Intensive Blood-Pressure Lowering (N = 1399)	Guideline-Recommended Blood-Pressure Lowering (N = 1430)	Odds Ratio (95% CI)	P Value
Primary outcome: death or major disability — no./total no. (%)†	719/1382 (52.0)	785/1412 (55.6)	0.87 (0.75–1.01)	0.06
Secondary outcomes				
Score on the modified Rankin scale — no./total no. (%)‡			0.87 (0.77–1.00)	0.04

The Intracerebral Hemorrhage Acutely Decreasing Arterial Pressure Trial

Table 1. Baseline Characteristics of Randomized Patients

	<150 mm Hg Target (n=39)	<180 mm Hg Target (n=36)	*P* Value
Age (mean±SD)	70.7±12.5	68.7±11.1	0.46
Male	26 (67%)	28 (78%)	0.28
Symptom onset to randomization (median, IQR)	7.83 (3.25–16.75)	8.54 (3.80–15.75)	0.94
Randomized <6 h	18 (46%)	17 (42%)	0.93

Table 2. Effects of Blood Pressure Treatment on Cerebral Perfusion, Hemorrhage Growth, and Clinical Outcome

	<150 mm Hg Target (n=37)	<180 mm Hg Target (n=36)	*P* Value
Relative perfusion measures (mean±SD)			
Perihematoma rCBF	0.86±0.12	0.89±0.09	0.18
Ipsilateral hemispheric rCBF	0.95±0.05	0.99±0.05	0.001
Perihematoma rCBV	0.90±0.14	0.91±0.15	0.73
Ipsilateral hemispheric rCBV	0.98±0.05	0.99±0.06	0.59
Clinical outcomes (median, IQR)			
GCS Score (2 h)	15 (11–15)	15 (13–15)	0.50
NIHSS Score (2 h)	11 (6–17)	13 (5–17)	0.75
GCS Score (24 h)	15 (10.75–15)	14 (13–15)	0.64
NIHSS Score (24 h)	10 (5–19)	12 (6–20)	0.85
30-day mortality	7 (17.9%)	4 (11.1%)	0.40
90-day Barthel Index	95 (70–100)	95 (40–100)	0.51
90-day mRS	2.5 (1–5.75)	4 (2–5)	0.65

MEMO

Early seizures in intracerebral hemorrhage
Incidence, associated factors, and outcome

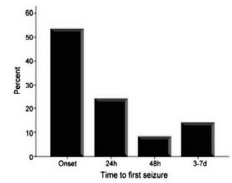


Table 1 Factors associated with early seizures: Results of bivariate analyses for categorical variables[a]

	All patients (n = 522)	Patients with ES (n = 71)	p Value
Vascular risk factors, n (%)			
Male gender	274 (52)	41 (58)	0.368
Arterial hypertension	334 (64)	45 (63)	0.904
Diabetes	78 (15)	7 (10)	0.202
Hypercholesterolemia	154 (30)	22 (31)	0.770
Alcohol abuse[b]	129 (25)	23 (32)	0.124
Smoking[c]	98 (19)	15 (21)	0.671
Radiologic data, n (%)			
Cortical involvement	197 (38)	38 (54)	0.002
Intraventricular extension	257 (49)	30 (42)	0.332
Subarachnoid extension	113 (22)	16 (23)	0.680
Subdural extension	29 (6)	4 (6)	0.861
Hydrocephaly	100 (19)	11 (15)	0.700
Midline shift	200 (38)	24 (34)	0.663
Multiple ICHs	31 (6)	7 (10)	0.072
Lobar location[d]	167 (32)	36 (51)	<0.001
Presence of old lesion[b]	76 (15)	12 (17)	0.515
Presence of lacunes[b]	168 (32)	23 (32)	0.988

Prophylactic Antiepileptic Drug Use is Associated with Poor Outcome Following ICH Neurocrit Care (2009) 11:38–44
for the CHANT investigators

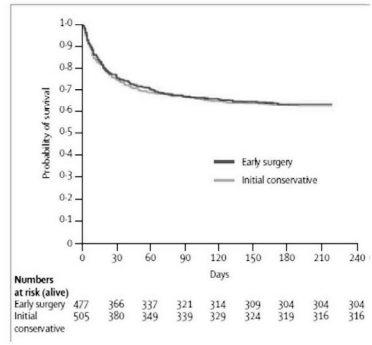
	Poor outcome	Good outcome	*P*
Age (years), median (IQR)	73 (65–78)	63 (56–73)	<0.001
Male sex	57/82 (70%)	134/209 (64%)	0.38
Hematoma volume (ml), median (IQR)	33 (14–57)	13 (6–22)	<0.001
Intraventricular hemorrhage	43/82 (52%)	57/209 (27%)	<0.001
Lobar location of hemorrhage	21/82 (26%)	25/209 (12%)	0.004
Infratentorial hemorrhage location	1/82 (1%)	7/209 (3%)	0.32
Glasgow coma score, median (IQR)	14 (12–15)	15 (14–15)	<0.001
AED use	15/82 (18%)	8/209 (4%)	<0.001
Prior warfarin use	14/82 (17%)	6/209 (3%)	<0.001
Surgical intervention	8/82 (10%)	7/209 (3%)	0.03
ICH score ≥2	36/82 (44%)	23/209 (11%)	<0.001

Table 3 Multivariable logistic regression model to predict poor outcome (defined as a modified Rankin score of 5 or 6) at day 90

	OR	95% CI	*P*
Age (per year)	1.06	1.03–1.10	<0.001
Hematoma volume (per ml)	1.04	1.02–1.06	<0.001
Presence of intraventricular blood	2.98	1.54–5.76	0.001
Glasgow coma score (per point)	0.82	0.68–0.99	0.04
Prior warfarin use	4.03	1.06–15.28	0.04
AED use	6.83	2.20–21.23	0.001

Early surgery versus initial conservative treatment in patients with spontaneous supratentorial intracerebral haematomas in the International Surgical Trial in Intracerebral Haemorrhage (STICH): a randomised trial

Lancet 2005; 365: 387–97



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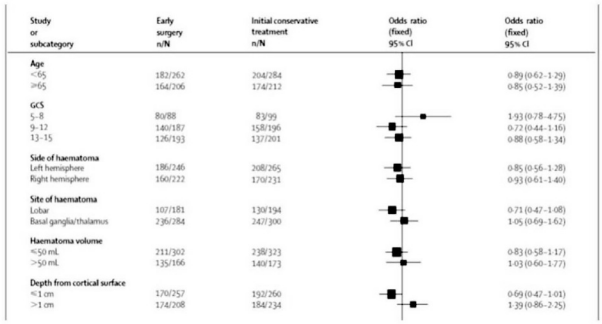


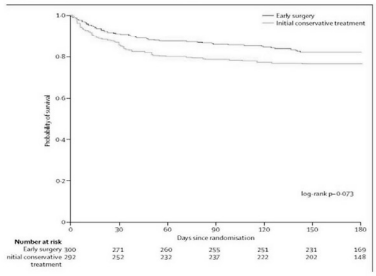
Study or subcategory	Early surgery n/N	Initial conservative treatment n/N	Odds ratio (fixed) 95% CI	Odds ratio (fixed) 95% CI
Age				
<65	182/262	204/284		0·89 (0·62–1·29)
≥65	164/206	174/212		0·85 (0·52–1·39)
GCS				
5–8	80/88	83/99		1·93 (0·78–4·75)
9–12	140/187	158/196		0·72 (0·44–1·16)
13–15	126/193	137/201		0·88 (0·58–1·34)
Side of haematoma				
Left hemisphere	186/246	208/265		0·85 (0·56–1·28)
Right hemisphere	160/222	170/231		0·93 (0·61–1·40)
Site of haematoma				
Lobar	107/181	130/194		0·71 (0·47–1·08)
Basal ganglia/thalamus	236/284	247/300		1·05 (0·69–1·62)
Haematoma volume				
≤50 mL	211/302	238/323		0·83 (0·58–1·17)
>50 mL	135/166	140/173		1·03 (0·60–1·77)
Depth from cortical surface				
≤1 cm	170/257	192/260		0·69 (0·47–1·01)
>1 cm	174/208	184/234		1·39 (0·86–2·25)

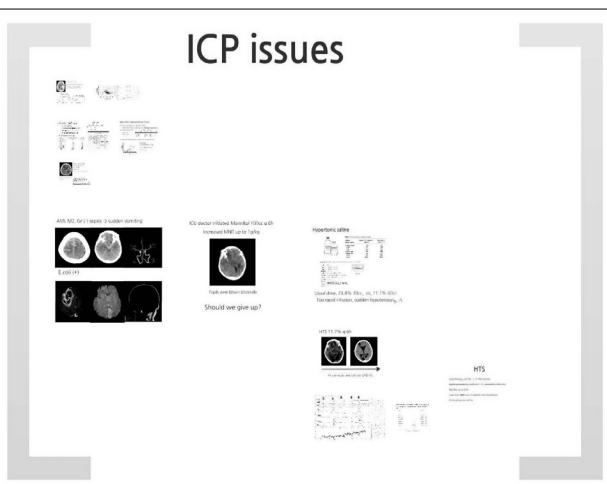
Early surgery versus initial conservative treatment in patients with spontaneous supratentorial lobar intracerebral haematomas (STICH II): a randomised trial

Lancet 2013; 382: 397–408

A David Mendelow, Barbara A Gregson, Elise N Rowan, Gordon D Murray, Anil Gholkar, Patrick M Mitchell, for the STICH II Investigators

	Early surgery group (n=288)	Initial conservative treatment group (n=62)
Surgery		
Craniotomy	284 (99%)	59 (95%)
Craniectomy	1 (<1%)	3 (5%)
Minimally invasive*	3 (1%)	..





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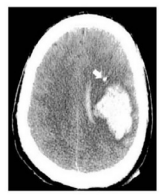
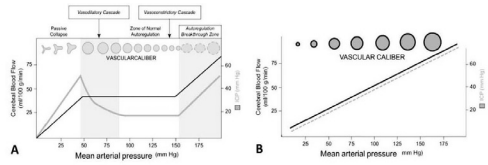
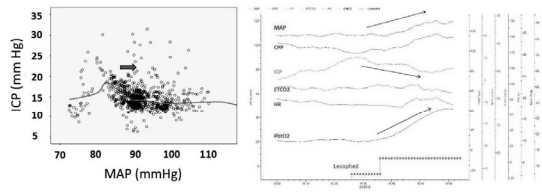


M/56 sudden vomiting
V/S: 96/55 - 102 - 25 - 37.2
What is the first step in ICP management?

1) Mannitol 2) Hyperventilation
3) Emergent surgery 4) BP elevation





- **Mannitol:** 184KD sugar
  - Osmotic diuresis
  - Rapid onset: within minutes
  - Last up to 5 hrs (Peak 2hrs)
  - Form: **15% -25%** g/100ml

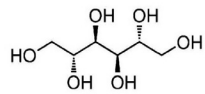


Table 1. Comparison of Osmotic Agents

Solution Concentration	Sodium Concentration (mEq/L)	Osmolarity (mOsm/L)
Ringer's lactate	130	275
0.009	154	308
0.02	242	684
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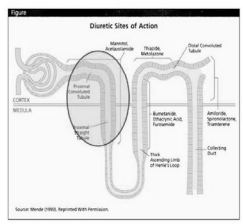
Mannitol 20%	n/a	1098
Mannitol 25%	n/a	1375
0.075	1283	2566
0.234	4004	8008



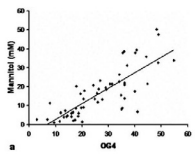
Mannitol induced kidney injury

1) Pre-renal azotemia: diuretic effect
   Myth: N/S 150cc replacement Maintain euvolemia
2) high osmolarity?
   s-osm: 320
   HTS: less AKI

Osmolality and osmotic gap

Timing of Measurement	No MI-ARI*	MI-ARI*	p Value†
osmolality (mOsm/kg)			
baseline	301 ± 9	303 ± 4	0.556
before MI-ARI	320 ± 22	322 ± 23	0.481
peak	320 ± 22	344 ± 25	0.025

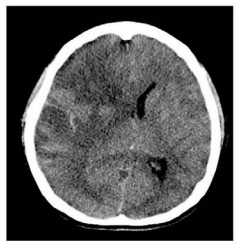
3) Direct tubular damage: Mannitol concentration



Mannitol
concentration ~ OG

Na, glu, BUN monitoring

OG = 55 : safe



M/48 180cm, 80kg
extensor posturing
BP: 160/88
Mannitol ?

1) 50cc 2) 100cc 3) 150cc 4)200cc

Minimum effective MNT dose
= 0.5g/kg

Major Clinical and Physiological Benefits of Early High Doses of Mannitol for Intraparenchymal Temporal Lobe Hemorrhages with Abnormal Pupillary Widening: A Randomized Trial

TABLE 3. Early improvement of bilateral pupillary widening in the two groups of patients*

Pupillary improvement	No. of patients		
	HDM group	CDM group	Total
Yes	10	3	13
No	5	10	15

TABLE 4. Early improvement of unilateral pupillary widening in the two groups of patients*

Pupillary improvement	No. of patients		
	HDM group	CDM group	Total
Yes	44	29	73
No	13	27	40

Major Clinical and Physiological Benefits of Early High Doses of Mannitol for Intraparenchymal Temporal Lobe Hemorrhages with Abnormal Pupillary Widening: A Randomized Trial

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MEMO

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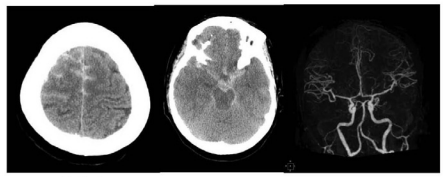
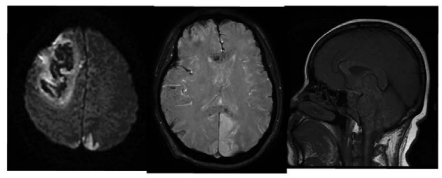
AML M2, Gr (-) sepsis -> sudden vomiting

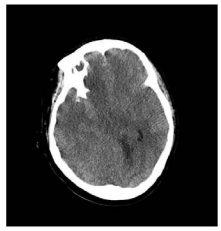


E.coli (+)



ICU doctor initiated Mannitol 100cc q 6h

Increased MNT up to 1g/kg



Pupils were blown bilaterally

Should we give up?

Hypertonic saline

Table 1. Comparison of Osmotic Agents

Solution Concentration	Sodium Concentration (mEq/L)	Osmolarity (mOsm/L)
Ringer's lactate	130	275
0.009	154	308
0.02	242	484
0.03	513	1062
Mannitol 20%	n/a	1098
Mannitol 25%	n/a	1375
0.075	1283	2566
0.234	4004	8008

Usual dose, 23.4% 30cc, so, 11.7% 60cc

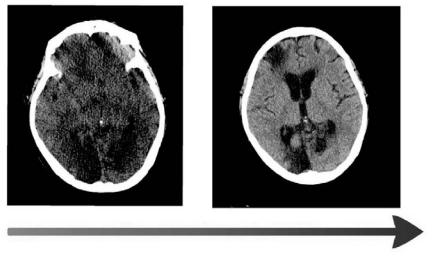
Too rapid infusion, sudden hypotension

MEMO

Table 1. Systemic Responses to Rapid Hypertonic Saline Infusion

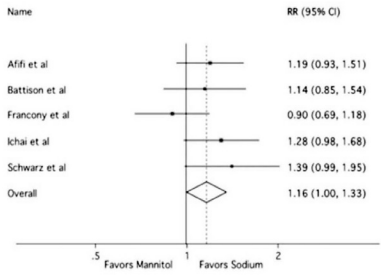
		Time after HTS administration	
	Baseline	45 s	5 min
HR (beats/min)	101 ± 8	103 ± 6	114 ± 9[a]
MAP (mm Hg)	95 ± 4	51 ± 5[a]	113 ± 8[a,b]
PP (mm Hg)	36 ± 3	48 ± 4[a]	47 ± 4[a]
MPAP (mm Hg)	14 ± 1	17 ± 1[a]	15 ± 1
CO (L/min)	2.8 ± 1.0	3.9 ± 1.1[a]	4.0 ± 0.9[a]
SV (mL)	26.4 ± 1.5	38.5 ± 1.9[a]	34.3 ± 2.1[a]
SVR (dynes·s·cm^{-5})	2628 ± 220	1069 ± 159[a]	2071 ± 367[a,b]
PVR (dynes·s·cm^{-5})	261 ± 18	187 ± 16[a]	174 ± 23[a]

HTS 11.7% q 6h



Pt can walk and talk on OPD f/u

Hypertonic saline versus mannitol for the treatment of elevated intracranial pressure: A meta-analysis of randomized clinical trials*



MEMO

HTS

Bolus therapy, not 3% -> 11.7% in Korea

Higher permeability coefficient 1.0, compared to Mannitol

May last up to 4-6hr

Safer than MNT even in patients with renal failure

Preferred via Central line