

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?



NIHSS Acute Stroke Scale

Item	Score	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79	80	81	82	83	84	85	86	87	88	89	90	91	92	93	94	95	96	97	98	99	100
1	LOC	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79	80	81	82	83	84	85	86	87	88	89	90	91	92	93	94	95	96	97	98	99	100	



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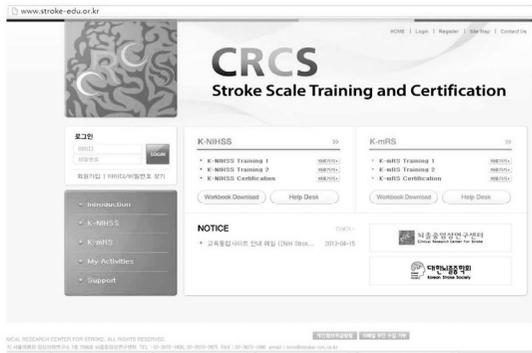
Integrated Acute Stroke Flowsheet
National Institutes of Health Stroke Scale

Complete a full assessment (75) during the first 72 hours after admission for stroke, with any decline in neurological status, and when the patient is enrolled from EMS, EMT, or FACTS into NHTF or Observation. Add to the 72-hour period, a full assessment identified to correspond with any change in level of status, and prior to discharge.
Complete a modified assessment (6) - modified version, and any other areas of concern when the neurological assessment is not available.
Assessments (NIHSS) are done daily. Record any findings that are significant to the stroke and/or stroke care. Do not skip any items and change scores. Scores should reflect what the patient does, and not what the clinician thinks the patient can do. If a patient is not able to perform an item, the item should be marked as "not applicable" or "not performed" (N/A).
If a patient is not able to perform an item, the item should be marked as "not applicable" or "not performed" (N/A).

CATEGORY	Description	0		1		2		3		4		5		6		7		8		9		10		11		12		13		14		15		16		17		18		19		20		21		22		23		24		25		26		27		28		29		30		31		32		33		34		35		36		37		38		39		40		41		42		43		44		45		46		47		48		49		50		51		52		53		54		55		56		57		58		59		60		61		62		63		64		65		66		67		68		69		70		71		72		73		74		75		76		77		78		79		80		81		82		83		84		85		86		87		88		89		90		91		92		93		94		95		96		97		98		99		100	
		1	LOC	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79	80	81	82	83	84	85	86	87	88	89	90	91	92	93	94	95	96	97	98	99	100																																																																																																				

TOTAL SCORE
Left Side/Right Side
NIHSS Item 2000 Score Sheet Form Name: Stroke Exam Score Sheet
Revisions: 1/2000, 2/2001, 3/2002, 4/2003, 5/2004, 6/2005, 7/2006, 8/2007, 9/2008, 10/2009, 11/2010, 12/2011, 1/2012, 2/2013, 3/2014, 4/2015, 5/2016, 6/2017, 7/2018, 8/2019, 9/2020, 10/2021, 11/2022, 12/2023, 1/2024, 2/2025, 3/2026, 4/2027, 5/2028, 6/2029, 7/2030, 8/2031, 9/2032, 10/2033, 11/2034, 12/2035, 1/2036, 2/2037, 3/2038, 4/2039, 5/2040, 6/2041, 7/2042, 8/2043, 9/2044, 10/2045, 11/2046, 12/2047, 1/2048, 2/2049, 3/2050, 4/2051, 5/2052, 6/2053, 7/2054, 8/2055, 9/2056, 10/2057, 11/2058, 12/2059, 1/2060, 2/2061, 3/2062, 4/2063, 5/2064, 6/2065, 7/2066, 8/2067, 9/2068, 10/2069, 11/2070, 12/2071, 1/2072, 2/2073, 3/2074, 4/2075, 5/2076, 6/2077, 7/2078, 8/2079, 9/2080, 10/2081, 11/2082, 12/2083, 1/2084, 2/2085, 3/2086, 4/2087, 5/2088, 6/2089, 7/2090, 8/2091, 9/2092, 10/2093, 11/2094, 12/2095, 1/2096, 2/2097, 3/2098, 4/2099, 5/2100, 6/2101, 7/2102, 8/2103, 9/2104, 10/2105, 11/2106, 12/2107, 1/2108, 2/2109, 3/2110, 4/2111, 5/2112, 6/2113, 7/2114, 8/2115, 9/2116, 10/2117, 11/2118, 12/2119, 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MEMO



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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

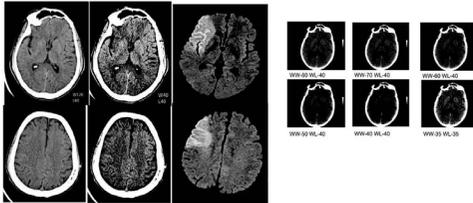
no change in clinical decision process

MEMO

Early ischemic signs

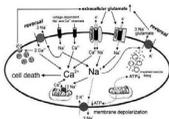
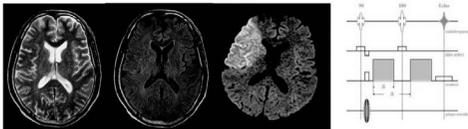
- 1) Gray-white loss of differentiation
- 2) BG low density
- 3) Insular ribbon sign

For better sensitivity, change W40/L40



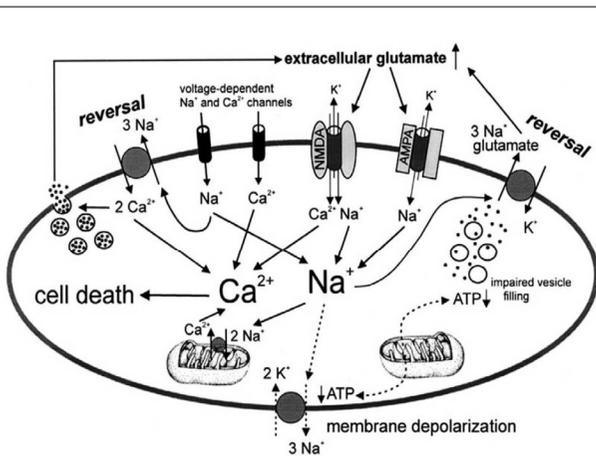
Brain MR

More sensitive to ischemia compared to CT



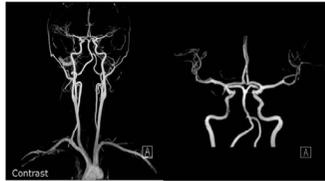
Water molecule Brownian movement

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

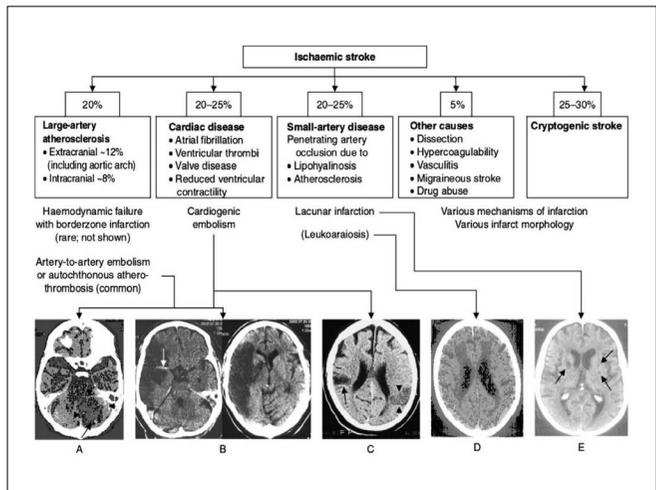


MEMO

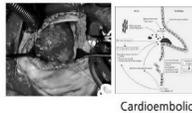
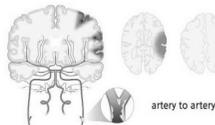
MRA



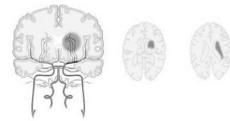
Parenchymal imaging + Vessel imaging
-> stroke mechanism



Embolitic



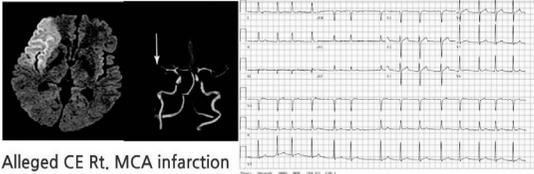
Thrombotic



Lacune



Our patient, M/75, LNT 4h

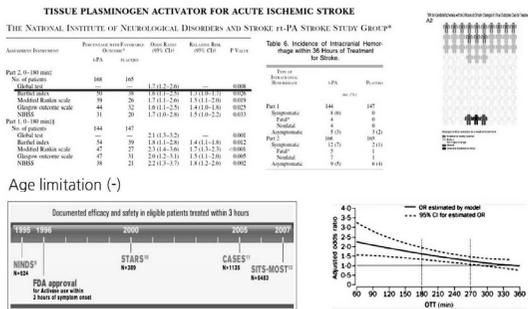


Alleged CE Rt. MCA infarction

Q3. What is your next step?

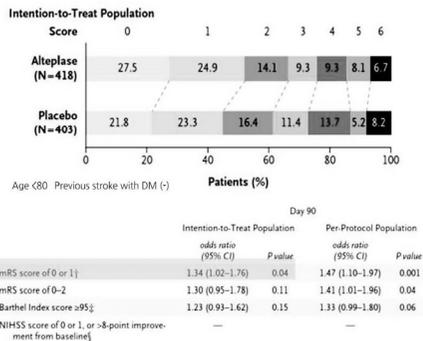
- 1) Aspirin 300mg 투약
- 2) Vessel 이 막혔으므로 tPA 는 시간관계없이 사용
- 3) Vessel 이 막혀서 IA thrombolysis
- 4) 영상소견 관계없이 tPA candidate
- 5) Hemispherectomy 수술

MEMO



Thrombolysis with Alteplase 3 to 4.5 Hours after Acute Ischemic Stroke

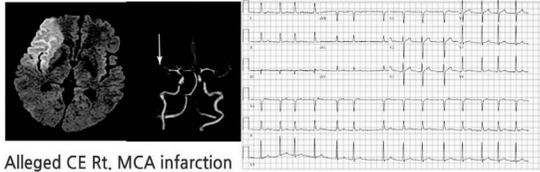
N Engl J Med 2008;359:1317-29



MEMO

	3h	4.5h
Age <80	O	O <small>2014.1 부터가능</small>
Age >80	O 비보험	X

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) Hemispherectomy 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



1) 두개내출혈(Intracranial hemorrhage)의 위험이 없어야 함
 2) 혈압은 4-6시간 동안 185mmHg 이하로 유지시켜 150mmHg 이하로 낮출 때까지 함
 3) 신계 질환, 담낭, 출혈성 이상증상을 유발하지 않아야 함
 4) 경부 동맥과정을 통과하고 있다면 최대 1.7 리터까지 함
 5) 과거 6시간 이내 제외관출 적이 없어야 함, aPTT가 정상범위 이내로 조절되어야 함
 6) 100kg 이상
 7) 4시간 동안 180mmHg 이하로 유지시켜 150mmHg 이하로 낮출 것
 8) Labetalol 50mg 정제 투약한다. 1시간 동안 160mmHg 이하로 유지시켜 150mmHg 이하로 낮출 것
 9) 100kg 이상 150kg 이하의 경우 1.7 리터까지 함

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?

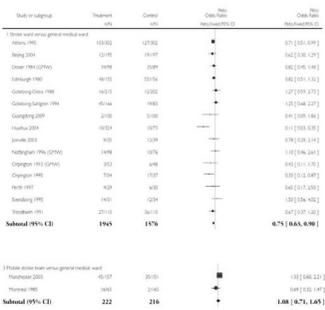
- A) Admission to ICU
- B) minor stroke, admission to General ward
- C) admission to Stroke unit
- D) Discharge the patient



MEMO

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

사망률

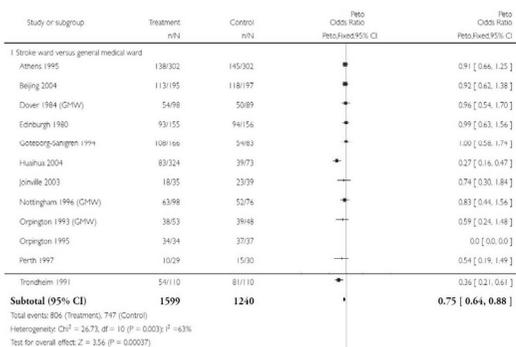


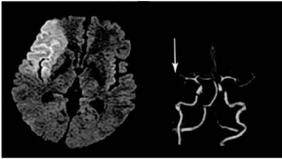
Review: Organised specialist (stroke unit) care for stroke

Comparison: 1 Organised stroke unit care versus alternative service

Outcome: 3 Death or dependency by the end of scheduled follow-up

사망 혹은 중증도 장애율





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

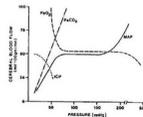
Routine Oxygen is not beneficial

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: 733-37

Source: M.Zink, Stroke, on behalf of the ASPIS investigators

Score	0	1	2	3	4	5	6
Standard treatment (n=320)	9.7% (31)	23.6% (76)	25.9% (83)	17.8% (57)	13.8% (43)	2.5% (8)	9.7% (31)
Aspirin (n=322)	18.3% (59)	16.8% (54)	73.0% (231)	20.2% (65)	11.7% (37)	3.4% (11)	11.7% (37)
	0	25	50	75	100	125	150
	Patients (%)						

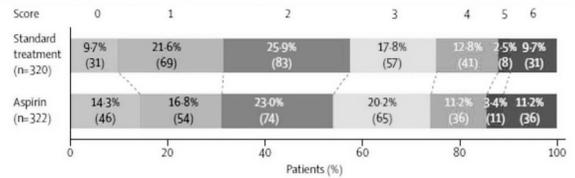
	Aspirin (n=322)	Standard treatment (n=320)	Relative risk (95% CI)	p-value*
Initial ischaemic stroke (including progressive stroke)	99 (30.7%)	102 (31.9%)	0.99 (0.79 to 1.24)	0.95
Recurrent ischaemic stroke	10 (3.1%)	11 (3.4%)	0.90 (0.47 to 1.69)	0.69
Symptomatic intracerebral haemorrhage	11 (3.4%)	10 (3.1%)	0.93 (0.33 to 2.55)	0.86

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

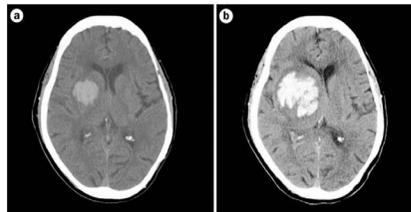
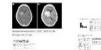
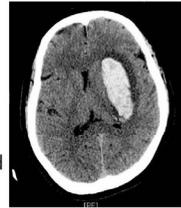


	Aspirin (n=148)	Standard treatment (n=137)	Relative risk (95% CI)	p value*
Initial ischaemic stroke (including progressive stroke)	99 (66.9%)	102 (74.5%)	0.90 (0.77 to 1.04)	0.16
Recurrent ischaemic stroke	10 (6.8%)	3 (2.2%)	3.09 (0.87 to 10.89)	0.09
Symptomatic intracranial haemorrhage	11 (7.4%)	1 (0.7%)	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

Intensive blood pressure reduction in acute cerebral haemorrhage (ARTIS2): randomised clinical trial

Outcome	Intensive BP reduction (n=100)	Standard BP reduction (n=100)
Primary outcome (mRS at 90 days)	10 (10%)	15 (15%)
Secondary outcome (mRS at 90 days)	10 (10%)	15 (15%)
Relative risk (95% CI)	0.67 (0.42 to 1.07)	

Effect of Blood Pressure Control in Patients with Acute Intracerebral Hemorrhage

Outcome	Intensive BP reduction (n=100)	Standard BP reduction (n=100)
Primary outcome (mRS at 90 days)	10 (10%)	15 (15%)
Secondary outcome (mRS at 90 days)	10 (10%)	15 (15%)
Relative risk (95% CI)	0.67 (0.42 to 1.07)	

MEMO

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

Lancet Neurol 2008; 7: 393-99

	Guideline (n=201)	Intensive (n=203)		
Median time from ICH onset to randomisation (hr:min)	3:36 (2:54-4:54)	3:42 (2:54-4:48)		
Age (years)	63 (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
Haematomas				
Mean baseline volume (mL)	12.7 (11.6)	14.3 (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% (9.6 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% (0.8 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 mmHg Target (n=39)	<180 mmHg Target (n=36)	P
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 mmHg Target (n=37)	<180 mmHg 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 CBV	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
mRS Score (2 h)	11 (6–17)	13 (5–17)	0.75
GCS Score (24 h)	15 (10–15)	14 (10–15)	0.64
mRS Score (24 h)	19 (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 (2–9)	0.65

MEMO

Early seizures in intracerebral hemorrhage

Incidence, associated factors, and outcome

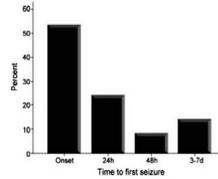


Table 1 Factors associated with early seizures: Results of bivariate analyses for categorical variables*

	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 ^a	129 (25)	23 (32)	0.124
Smoking ^a	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 ^a	157 (30)	39 (55)	<0.001
Presence of old lesion ^a	76 (15)	12 (17)	0.515
Presence of lacunes ^a	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

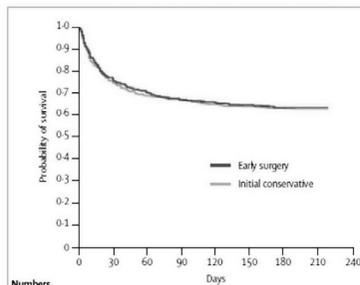
	Poor outcome (n, %)	Good outcome (n, %)	P
Age (years), median (IQR)	73 (65-78)	63 (56-73)	<0.001
Male sex	57/82 (70%)	134/209 (64%)	0.38
Hematoma volume (ml), median (IQR)	33 (14-57)	13 (6-22)	<0.001
Intraventricular hemorrhage	43/82 (52%)	57/209 (27%)	<0.001
Lobar location of hemorrhage	21/82 (26%)	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

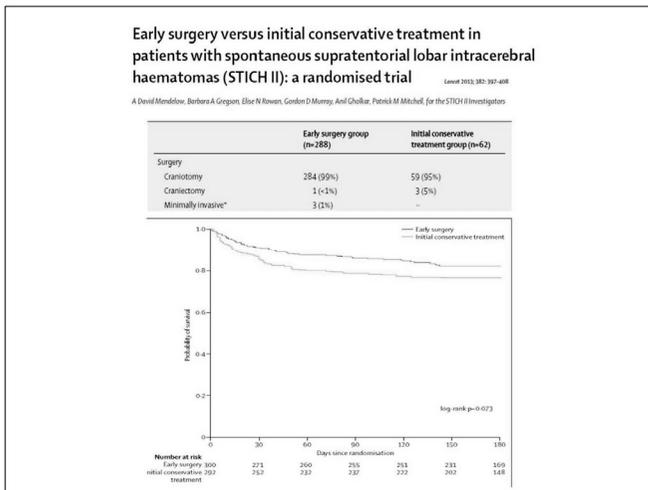
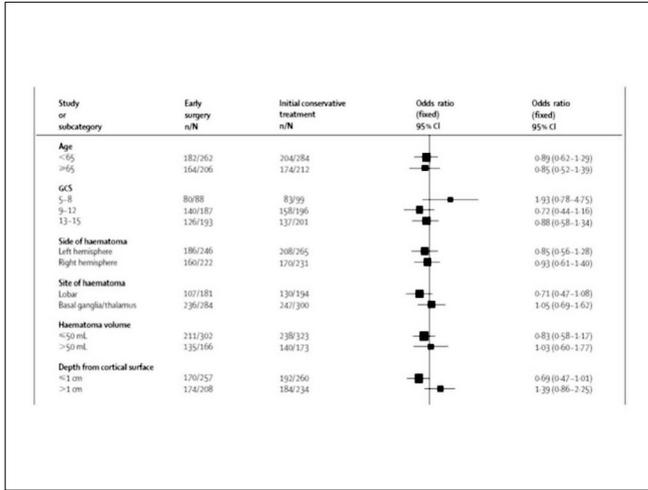
	OR	95% CI	P
Age (per year)	1.06	1.03-1.10	<0.001
Hematoma volume (per ml)	1.04	1.02-1.06	<0.001
Presence of intraventricular blood	2.98	1.54-5.76	0.001
Glasgow coma score (per point)	0.82	0.68-0.99	0.04
Prior warfarin use	4.03	1.06-15.28	0.04
AED use	6.83	2.20-21.23	0.001

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



MEMO



ICP issues

ATIS, NO, G or IIBER? > sudden-onset

ICP occur if/when? Monitor ICP, a 4h increase in ICP, up to 180%

Task: save brain structure

Should we give up?

Hyperosmotic saline

Goal: draw 20-30% NaCl, up to 11.7% NaCl, for 2-3 hours, under hyperosmotic, 3h

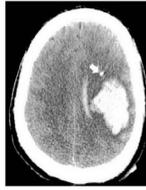
HTS

Hyperosmolar therapy

Indications: ICP > 20 mmHg, refractory to other treatments

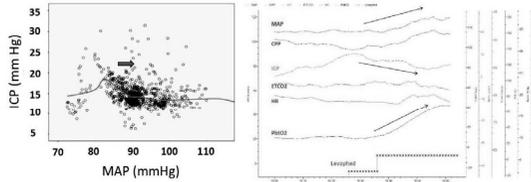
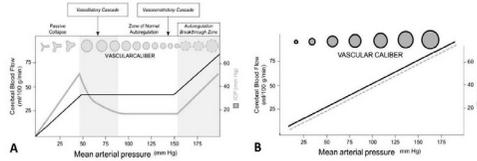
Contraindications: renal failure, hyponatremia, severe dehydration

MEMO



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

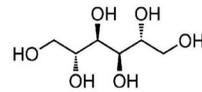
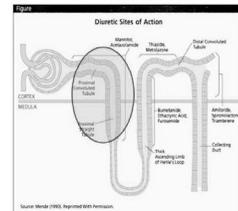


Table 1. Comparison of Osmotic Agents

Solution Concentration	Sodium Concentration (mEq/L)	Osmolarity (mOsm/L)
Ringer's lactate	130	275
0.009	154	308
0.02	242	684
0.03	513	1062
Mannitol 20%	n/a	1098
Mannitol 25%	n/a	1375
0.075	1283	2566
0.334	4004	8008



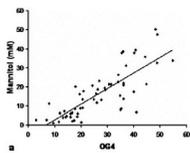
Mannitol induced kidney injury

- 1) Pre-renal azotemia: diuretic effect
Myth: N/S 150cc replacement Maintain euvolemia
- 2) high osmolarity?

s-osm: 320
HTS: less AKI

Timing of Measurement	Osmolality and osmotic gap		p Value ²
	No MI-ARI ¹	MI-ARI ¹	
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

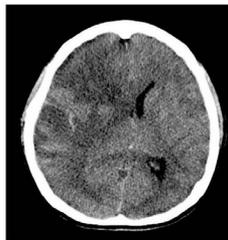
- 3) Direct tubular damage: Mannitol concentration



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 ^a				TABLE 4. Early improvement of unilateral pupillary widening in the two groups of patients ^a			
Pupillary improvement	No. of patients			Pupillary improvement	No. of patients		
	HDM group	CDM group	Total		HDM group	CDM group	Total
Yes	10	3	13	Yes	44	29	73
No	5	10	15	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

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

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	HDM group	CDM group	Total
Yes	10	3	13
No	5	10	15

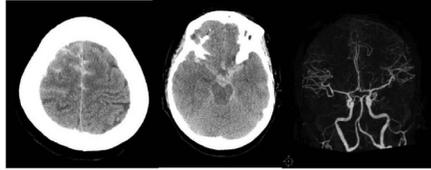
TABLE 4. Early improvement of unilateral pupillary widening in the two groups of patients^a

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

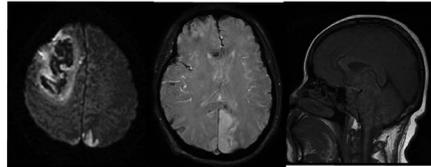
MEMO

MEMO

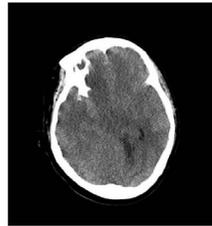
AML M2, Gr (-) sepsis -> sudden vomiting



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)	Osmolality (mOsm/L)
Ringer's lactate	130	275
0.9%	154	308
0.02	242	484
0.03	313	1062
Mannitol 20%	n/a	1090
Mannitol 25%	n/a	1375
0.075	1283	2566
0.234	4004	8008

신경과내과 4차 01111904 2004 2004 2004 2004 2004 2004 2004 2004 2004

23.4%
 11.7%
 0.9%
 0.02%
 0.03%
 Mannitol 20%
 Mannitol 25%
 0.075%
 0.234%

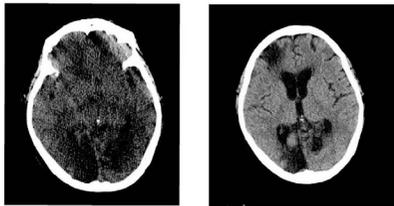
Usual dose, 23.4% 30cc, so, 11.7% 60cc
Too rapid infusion, sudden hypotension



Table 1. Systemic Responses to Rapid Hypertonic Saline Infusion

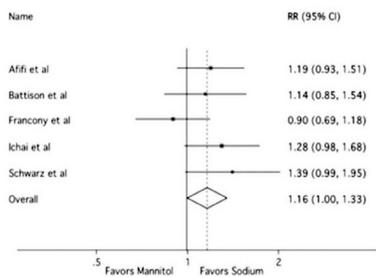
	Baseline	Time after HTS administration	
		45 s	5 min
HR (beats/min)	101 ± 8	103 ± 6	114 ± 9 ^a
MAP (mm Hg)	95 ± 4	51 ± 5 ^a	113 ± 8 ^{a,b}
PP (mm Hg)	36 ± 3	48 ± 4 ^a	47 ± 4 ^a
MPAP (mm Hg)	14 ± 1	17 ± 1 ^a	15 ± 1
CO (L/min)	2.8 ± 1.0	3.9 ± 1.1 ^a	4.0 ± 0.9 ^a
SV (mL)	26.4 ± 1.5	38.5 ± 1.9 ^a	34.3 ± 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

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