Landesklinikum BADEN-MÖDLING

Organizing acute stroke care

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Spring School 8.5.2019

Essentials to organize for acute stroke care

- Team
- Facilities
- Procedures
- Quality control
- Education

Team

- Physicians: Neurologists, geriatricians, EM physicians, cardiologist
- Nurse staff : spezialized in stroke care, ED nurse, hygiene professional
- Physiotherapists, SLT, occupational therapy, neuropsychologist, social worker
- Liasion: neurosurgery, ICU, csardiology , psychiatry
- Other : adminstrative, music therapist…

Facilities

- ED admission room
- Multimodal neuroimaging 24-7
- Routine radiology 24-7
- Lab including hemostasis 24-7
- SU beds + monitoring
- Special care beds (Respicare e.g.)
- Carotid US 24-7
- Echocardiography
- EEG

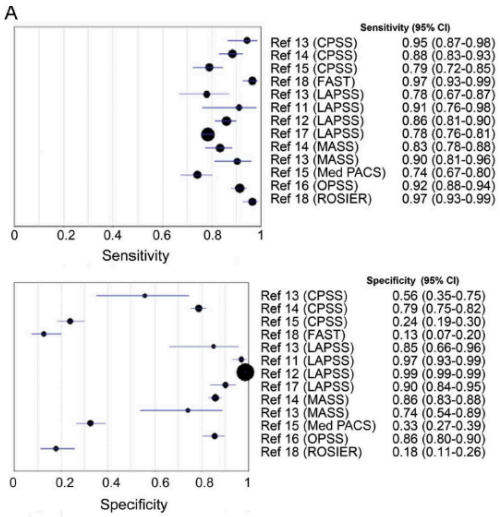
Procedures: time segments

- Prehospital phase
- Admission
- Acute diagnostic work up
- Recanalizing therapy
- Stroke unit
- Post-acute period

Prehospital phase

- Goals:
- To be fast &
- accurate

Accuracy of prehospital scales



Brandler ES, Sharma M, Sinert RH, Levine SR. Prehospital stroke scales in urban environments: a systematic review. Neurology. 2014 Jun 17;82(24):2241-9.

LOS ANGELES PREHOSPITAL STROKE SCREEN*

SCREENING CRITERIA	YES	NO	UNKNOWN
1. Age over 45 years			
2. History of seizures or epilepsy absent			
3. Symptom duration less than 24 hours			
4. At baseline, patient is not wheelchair bound or bedridden			
5. Blood glucose between 60 and 400			N/A
6. Exam: Look for obvious asymmetry			N/A

FACIAL SMILE/ GRIMACE	GRIP	ARM STRENGTH
☐ Normal	☐ Normal	☐ Normal
☐ Droop (Right)	☐ Weak grip (Right)	☐ Drifts down (Right)
☐ Droop (Left)	☐ Weak Grip (Left)	☐ Drifts down (Left)
	☐ No grip (Right)	☐ Falls rapidly (Right)
	☐ No Grip (Left)	☐ Falls rapidly (Left)

	YES	NO
Based on exam, patient has only unilateral (and not bilateral) weakness:		
7. If Yes (or unknown) to all items above LAPSS screening criteria met:		

8. If LAPSS criteria for stroke are met, call receiving hospital with "CODE STROKE", if not then return to the appropriate treatment protocol.

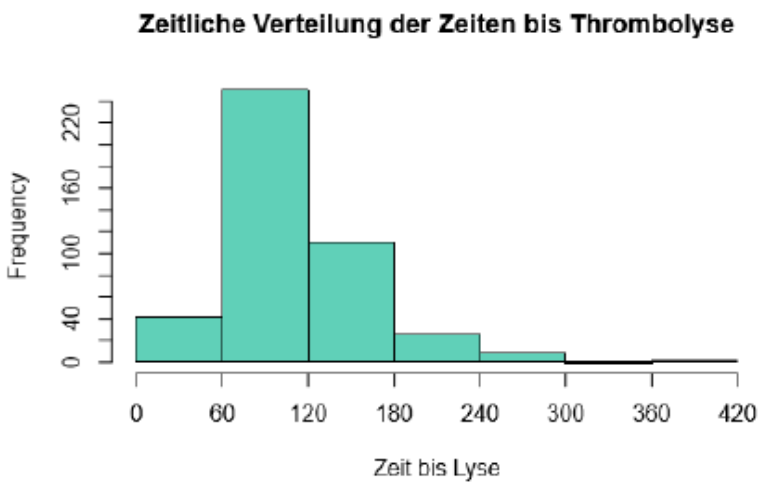
(Note: the patient may still be experiencing a stroke even if LAPSS criteria are not met)

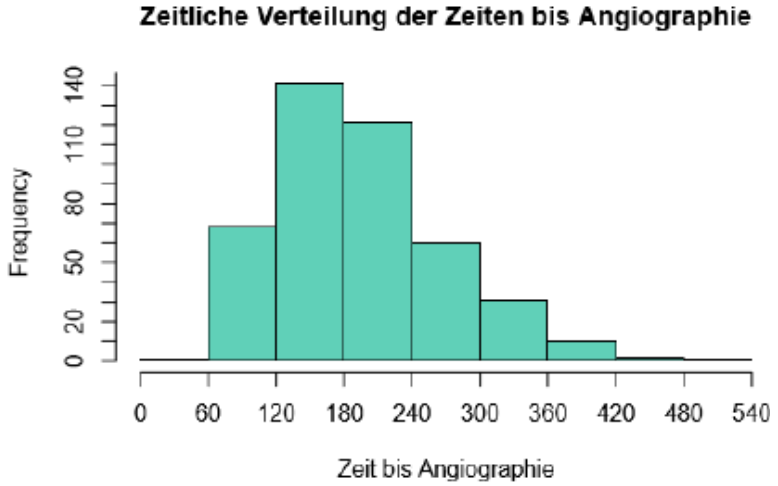
APSS Score

Item	Frage	Antwortmöglichkeiten	Text im Abfragestatus/Antworten für Übermittlung an Einsatzkräfte
Facialis (RACE, G-FAST)	Er/sie soll lächeln. War das Lächeln auf beiden Seiten gleich?	Ja, gleich	Lächeln seitengleich (APSS 0)
		Nein, unterschiedlich	Lächeln unterschiedlich (APSS 1)
		Nicht ausgeführt, nicht beurteilbar	Lächeln nicht beurteilt (APSS 0)
Speech (G-FAST)	Er/sie soll folgenden Satz wiederholen: "Die Blumen blühen auf der Wiese." War das deutlich und verständlich?	Ja, deutlich und verständlich	Sprechen deutlich (APSS 0)
		Nein, undeutlich oder verwaschen	Sprechen undeutlich (APSS 1)
		Nein, konnte nicht sprechen	Sprechen nicht möglich (APSS 2)
		Nicht ausgeführt, nicht beurteilbar	Sprechen nicht beurteilt (APSS 0)
Arm (RACE)	Er/sie soll beide Arme ausstrecken und hochhalten. War das auf beiden Seiten gleich?	Ja, gleich	Arme seitengleich (APSS 0)
		Nein, Unterschied oder Absinken	Arme unterschiedlich (APSS 1)
		Nein, nur mit einem Arm möglich	Arme nur einseitig beweglich (APSS 2)
		Nicht ausgeführt, nicht beurteilbar	Arme nicht beurteilt (APSS 0)
Wenn summierter APSS aus den ersten drei Items ≥1 --> weiter mit Items Leg, Gaze, Time			
Wenn summierter APSS aus den ersten drei Items =0 --> weiter mit Abfrageergebnis "Unklare neurologische Symptome"			
Leg (RACE)	Er/sie soll beide Beine anheben und hochhalten. War das auf beiden Seiten gleich?	Ja, gleich	Beine seitengleich (APSS 0)
		Nein, Unterschied oer Absinken	Beine unterschiedlich (APSS 1)
		Nein, nur mit einem Bein möglich	Beine nur einseitig beweglich (APSS 2)
		Nicht ausgeführt, nicht beurteilbar	Beine nicht beurteilt (APSS 0)
Gaze (RACE, G-FAST)	Kann er/sie den Kopf drehen und nach links und rechts blicken?	Bewegt Kopf	Kopf bewegt (APSS 0)
		Kopfbewegung nicht möglich, Blick starr in eine Richtung	Kopfbewegung nicht möglich, Blickstarre (APSS 2)
		Nicht ausgeführt oder nicht beurteilbar	Kopfbewegung nicht beurteilt (APSS 0)
Time (G-FAST)	Wann haben diese Beschwerden begonnen?	vor weniger als 1 Stunde	t <1h
		vor weniger als 2 Stunden	t <2h
		vor weniger als 3 Stunden	t <3h
		vor weniger als 4 Stunden	t <4h
		vor weniger als 5 Stunden	t <5h
		vor mehr als 5 Stunden	t > 5h
		unbekannt oder im Schlaf	t unbekannt

	Abfrageergebnis	Bedingung
Abfrageergebnisse Score von 0-9	Schwerer Schlaganfall (LVO, APSS ≥4, t <5h)	Score ≥4 und Time <5h
	Schwerer Schlaganfall (LVO, APSS ≥4, t <4h)	Score ≥4 und Time <4h
	Schwerer Schlaganfall (LVO, APSS ≥4, t <3h)	Score ≥4 und Time <3h
	Schwerer Schlaganfall (LVO, APSS ≥4, t <2h)	Score ≥4 und Time <2h
	Schwerer Schlaganfall (LVO, APSS ≥4, t <1h)	Score ≥4 und Time <1h
	Schwerer Schlaganfall (LVO, APSS ≥4, t unbekannt)	Score ≥4 und Time unbekannt
	Akuter Schlaganfall (APSS ≤3, t <5h)	Score ≤3 und Time <5h
	Akuter Schlaganfall (APSS ≤3, t <4h)	Score ≤3 und Time <4h
	Akuter Schlaganfall (APSS ≤3, t <3h)	Score ≤3 und Time <3h
	Akuter Schlaganfall (APSS ≤3, t <2h)	Score ≤3 und Time <2h
	Akuter Schlaganfall (APSS ≤3, t <1h)	Score ≤3 und Time <1h
	Akuter Schlaganfall (APSS ≤3, t unbekannt)	Score ≤3 und Time unbekannt
	Schlaganfall (APSS ≥1, t ≥5h)	Score ≥1 und Time ≥5h
	Unklare neurologische Symptome	Score 0

Goal : to improve time from trombolysis to angiografy
Preclinical selection for patients for thrombectomy





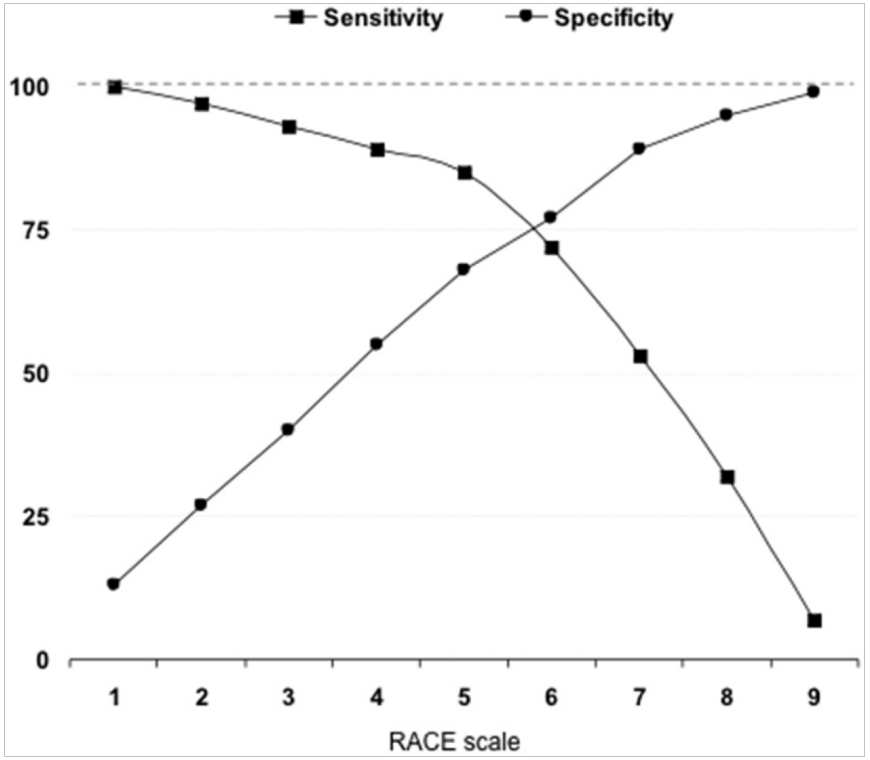
	Median (Q0.25, Q0.75) min
Zeit Ereignis bis Thrombolyse	103.5 (80, 135)
Zeit Ereignis bis Angiographie	175 (125, 234.8)
Zeit Ereignis bis Rekanalisation	219.5 (140, 290)

	N	%
Zeit von Lyse bis Angiographie [0;60 min],	194	35.5
Zeit von Lyse bis Angiographie [61;90 min]	108	19.8
Zeit von Lyse bis Angiographie [91;120 min]	76	13.9
Zeit von Lyse bis Angiographie >120	111	20.3

Fiehler et al. EROICAS. European Stroke Journal 2016

RACE score

RACE SCALE	
1. Facial palsy:	
Facial movement is normal, symmetric	0
Facial gesture when showing the teeth or smiling is slightly asymmetrical	1
Facial gesture when showing the teeth or smiling is completely asymmetrical	2
2. Arm motor function:	
Maintain the arm against gravity >10 seconds	0
Maintain the arm against gravity <10 seconds	1
Cannot maintain the arm against gravity and drops immediately	2
3. Leg motor function:	
Maintain the leg against gravity >5 seconds	0
Maintain the leg against gravity <5seconds	1
Cannot maintain the leg against gravity and drops immediately	2
4. Head and gaze deviation	
Absent	0
Present	1
5A. Agnosia / Negligence (if left hemiparesis)	
Asomatognosia (do not recognize the left part of his/her body) *Anosognosia (do not recognize his/her weakness)*	
There is no asomatognosia nor anosognosia	0
There is asomatognosia or anosognosia	1
There is asomatognosia and anosognosia	2
5B. Aphasia / Language (if right hemiparesis)	
Ask the patient: "Close your eyes" and "Make a fist"	
Perform both tasks correctly	0
Perform one task correclty	1
Perform neither tasks	2
TOTAL	



Perez de la Oza , et la, Stroke 2014

Mode of transport

- Goal: fast and direct to stroke unit or comprehensive stroke center

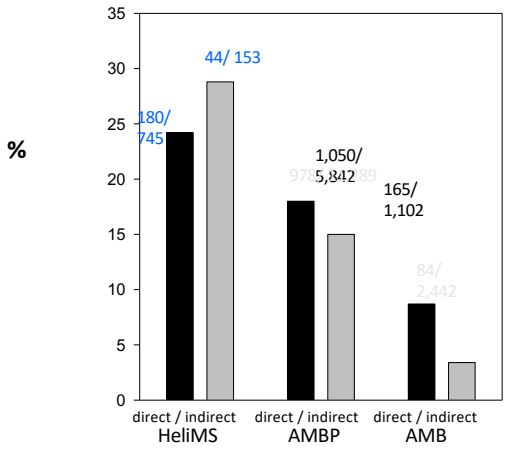
- Mobile stroke unit:
  - For big cities
- Helicopter transport

Helicopter Transport of Stroke Patients and Its Influence on Thrombolysis Rates

Data From the Austrian Stroke Unit Registry

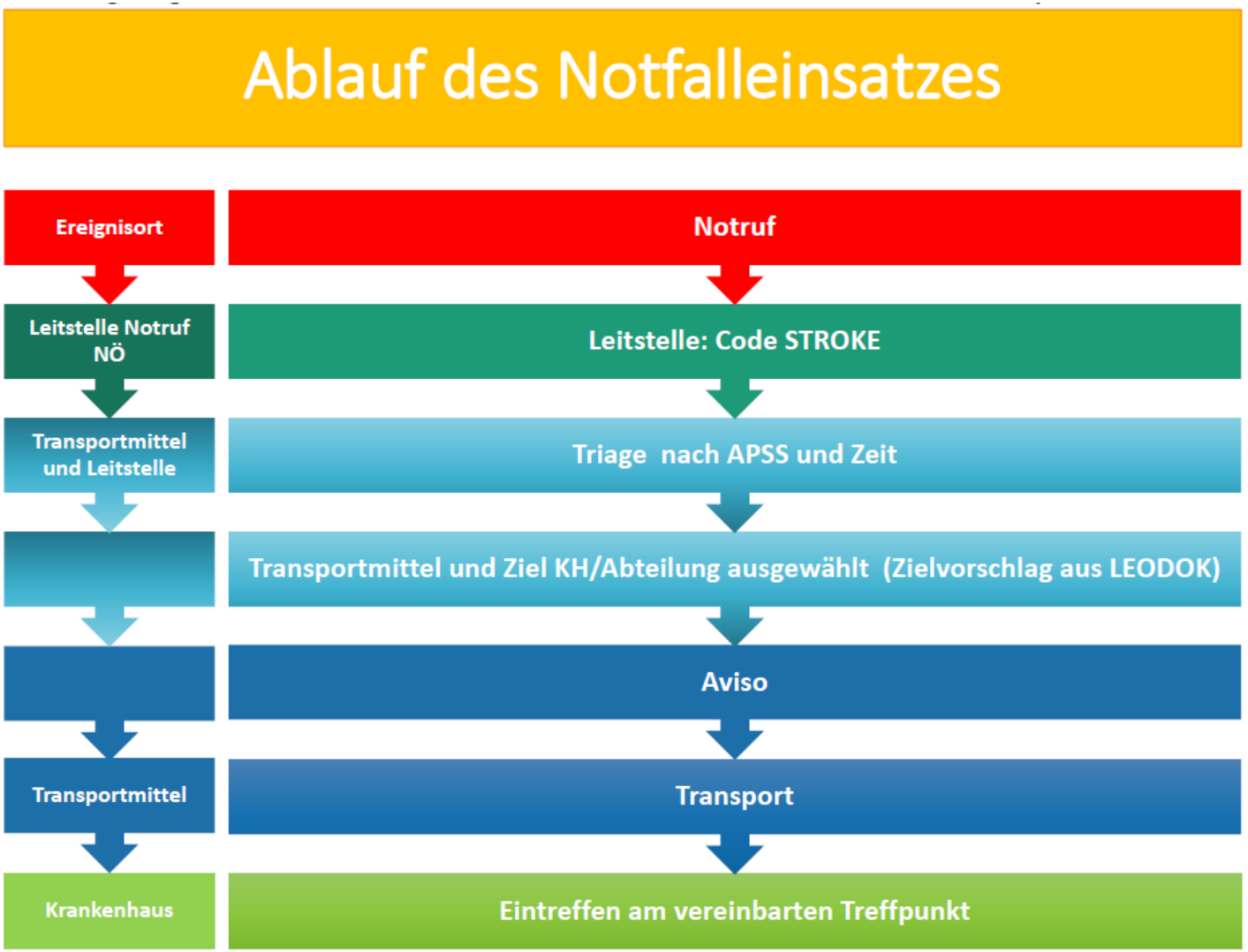
Veronika Reiner-Deitemyer, MD; Yvonne Teuschl, PhD; Karl Matz, MD; Martina Reiter, MD; Raoul Eckhardt, MD; Leonhard Seyfang, MSc; Claudia Tatschl, MD; Michael Brainin, MD; for the Austrian Stroke Unit Registry Collaborators

Percentages of thrombolyzed patients according to transport mode
(n = 2,501 thrombolyzed patients)



	OR	95% CI
<u>Transport</u>		
HEMS direct	1.28	1.01 - 1.62
HEMS indirect	3.59	2.15 – 5.97
AMBP direct	1.05	0.93 - 1.19
AMBP indirect	1.45	1.14 – 1.85
AMB direct	reference	
AMB indirect	0.54	0.41 - 0.71
<u>Times</u>		
>120 minutes	0.46	0.38 - 0.55
0 – 60 minutes	reference	

Flow chart of preclinical stroke management



Emergency diagnosis „ Acute Stroke“

Acute Stroke
APSS ≥ 1 , t 0-24h

- ***Fast transport to nearest SU***

APSS ≥4, t < 5h =
Severe ischemic stroke , susp. LVO > Thrombectomy?

APSS 1-3, t < 5h =
Ischemic stroke > Thrombolysis? (Thrombectomy)

APSS ≥1 , 5 h < t < 24h or unkonwn + *Last Seen Well* (LSW) < 24h =
Ischemic stroke > Thrombolysis/Thrombectomy? with mismatch-protocol

Acute Stroke + endangered vital functions

- ***Fast transport with emergency physician to ICU in hospital with Neurological departement***

- **Stabilization + Thrombolysis? Thrombectomy?**

Acute Stroke APSS ≥1 + severe disabling comorbidity *

- ***Nearest hospital***

- **ED and triage for most suitable department**

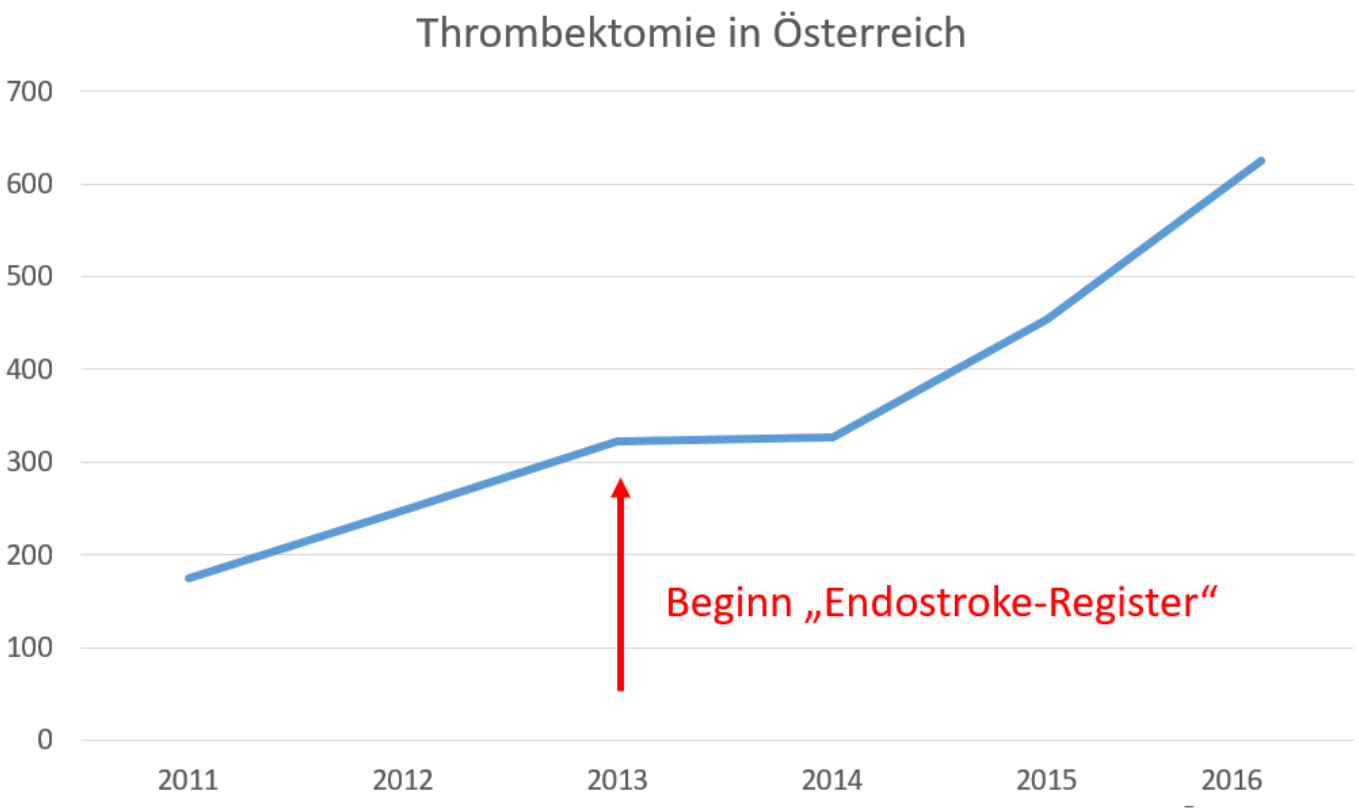
Thrombectomy - estimated incidence of acute LVO

- 24 / 100.000 persons p.a. (Rai et al J Intervent Surg 2016)
- Rund 10 - 22/ 100.000 persons p.a. Eligible for TE (Tsvigloulis J Neuroscience 2016, Chia Stroke 2016)

- 7 bis 12 % of all strokes (Chia Stroke 2016) , 25 % of strokes potentially ellgible for thrombolysis (Scheitz Stroke 2017)
- Comprehensiv storke centre: should perform 50 TEs min. p.a. (better >100) + other cerebrovascular neuroradiological interventions

- 1-2 CSCs per 1 Mio inhabitants

Thrrombectomy in Austria



Admission

- What is essential ?
  1. Standardized meeting point , close to imaging facilities
  2. Handing over the patient: short, should be trained.
     - Symptoms ? Onset ? Circumstances ? (eg injury, fall), essential medication (OAC), wittness (phone number)
  3. Paramedics: iv-line already in place, blood samples, ecg, vital signs: BP, pulse, sPO2, glucose
  4. If not by done by paramedics - > Stroke nurse /emergency staff nurse. See 3.

Door to needle time

Helsinki model cut stroke thrombolysis delays to 25 minutes in Melbourne in only 4 months.
Meretoja, Atte; MD, PhD; Weir, Louise; RN, NP; GradCertStrokeMgt, MANP; Ugalde, Melissa; RN, GradCertNeurosci; Yassi, Nawaf; MBBS, BSc; Yan, Bernard; MBBS, FRACP; Hand, Peter; MD, FRACP; Truesdale, Melinda; MBBS, GradDipHSM; Davis, Stephen; MD, FRACP; Campbell, Bruce; MBBS, BMedSc; PhD, FRACP

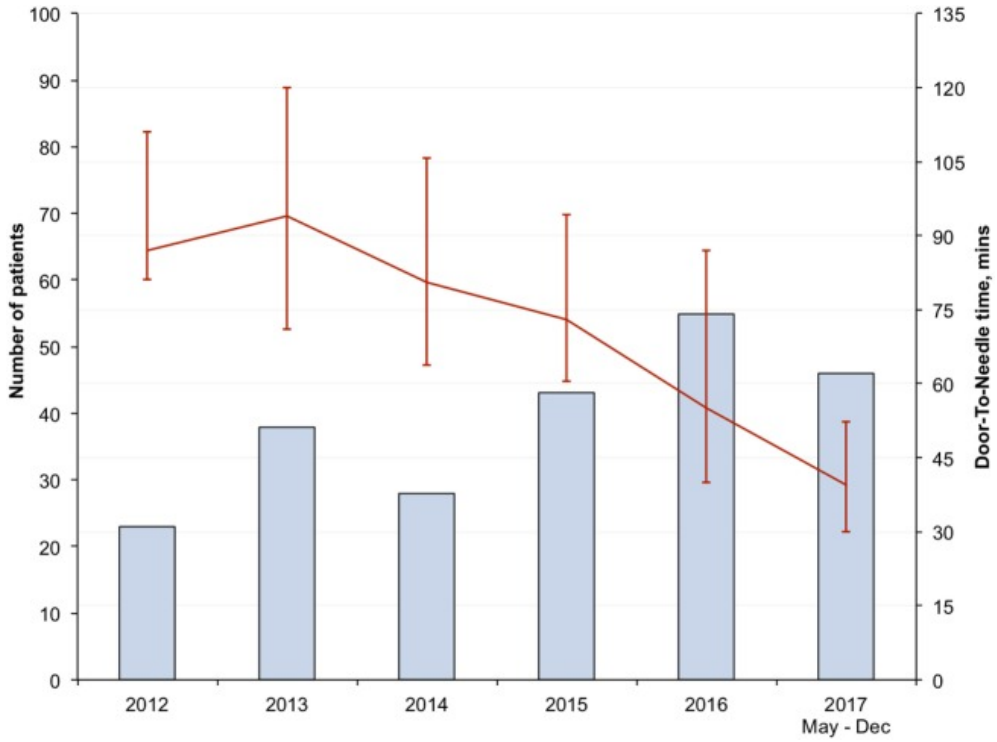
Neurology. 81(12):1071-1076, September 17, 2013.
DOI: 10.1212/WNL.0b013e3182a4a4d2

Table 1 Comparison of Helsinki and Royal Melbourne Hospital models

Step	Helsinki model	Existing RMH model	May 2012 additions to existing RMH model (estimated saved time per step)
Prenotification	Ambulance calls stroke consultant on mobile phone, who accepts patients, takes history, and alerts the team.	Ambulance calls hospital ED over open-air radio. Once ED has assessed patient, a "code stroke" page is sent to stroke team.	ED pages stroke team on receiving ambulance call—stroke team present on patient arrival (5–10 min saved). Stroke team calls ambulance dispatch center for patient details during transport (no time saved, allows for steps below).
Medical history	Electronic province-wide PACS since 2002. Electronic lab and patient records with limited access to GP text. GP never called.	Electronic local lab and PACS since 2007. Paper records. GP sometimes called to obtain detailed history.	When available, history, lab, and imaging evaluated and GP called before patient arrival (5 min).
Registration and CT request	Unique personal identification number at birth, used in all public and private systems. Patient registration and CT request electronically before patient arrival.	Noncentralized records with unique identifiers different for each hospital. CT requests only after patient had arrived and was registered in local hospital system.	Registration done before arrival to retrieve existing record or generate new record based on name and date of birth. CT request form prefilled (3 min).
Labs	Preordered blood tests for all tPA candidates. Blood samples always drawn before tPA by lab nurse. POC-INR, glucose available at tPA decision.	Routine blood samples often drawn after tPA initiation. Capillary glucose before tPA. Only wait for INR in known and suspected anticoagulated patients.	POC-INR available since 11/2012 (60 min in anticoagulated patients).
IV line	Ambulance always inserts large-bore antecubital cannula during transport.	IV access often available on arrival, otherwise inserted in ED.	IV access often available on arrival, otherwise inserted on CT table.
Straight to CT	Patients go straight to CT on ambulance stretchers.		Patients go straight to CT on ambulance stretchers (10 min).
tPA on CT table	tPA can be initiated on CT table, but usually in adjacent room where the drug is kept.		tPA and infusion kit brought to CT room beforehand. Bolus and infusion initiated on CT table (3 min).

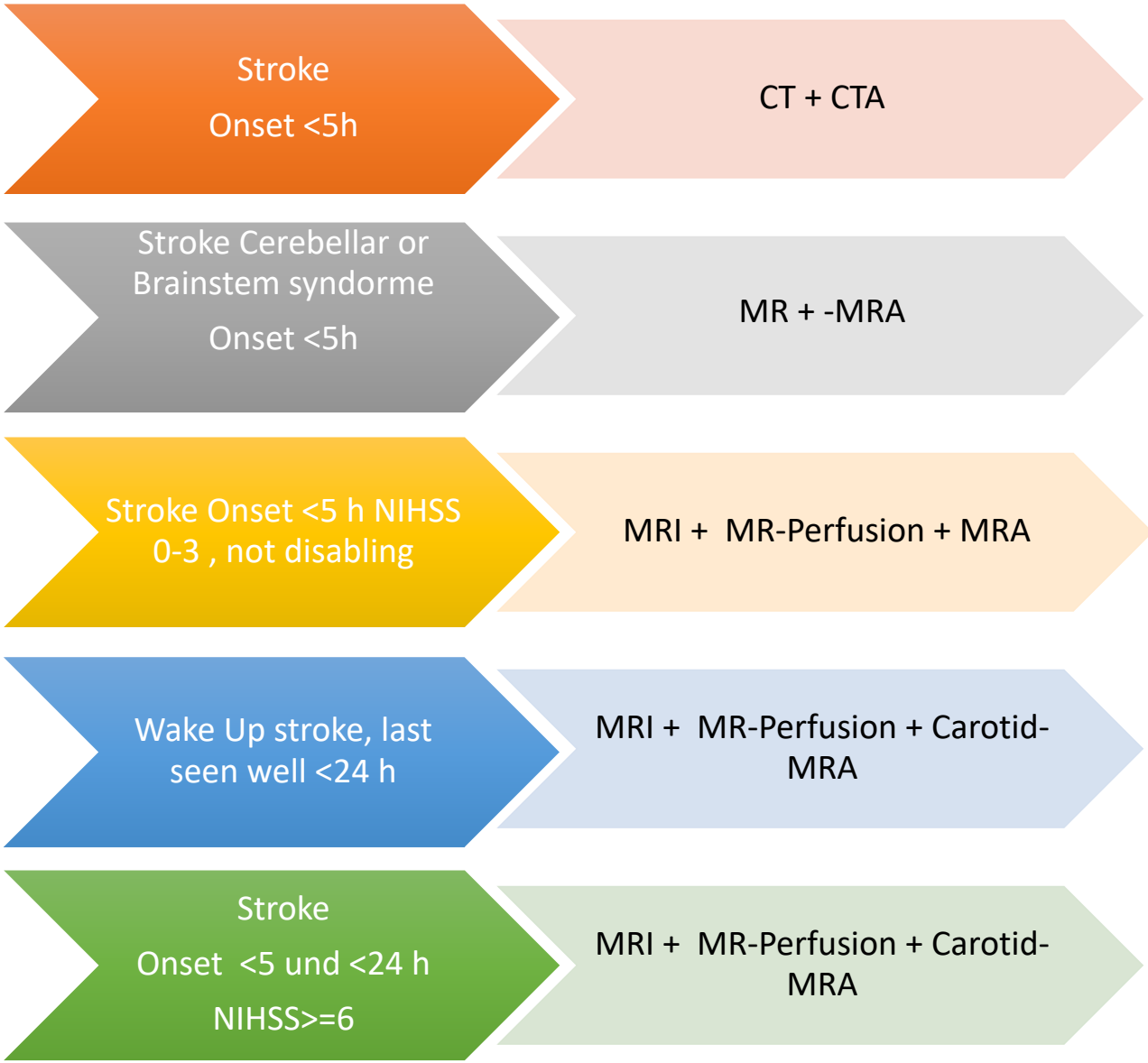
Abbreviations: ED = emergency department; GP = general practice; PACS = picture archiving and communication system; POC-INR = point-of-care international normalized ratio; RMH = Royal Melbourne Hospital; tPA = tissue plasminogen activator.

Door to needle time

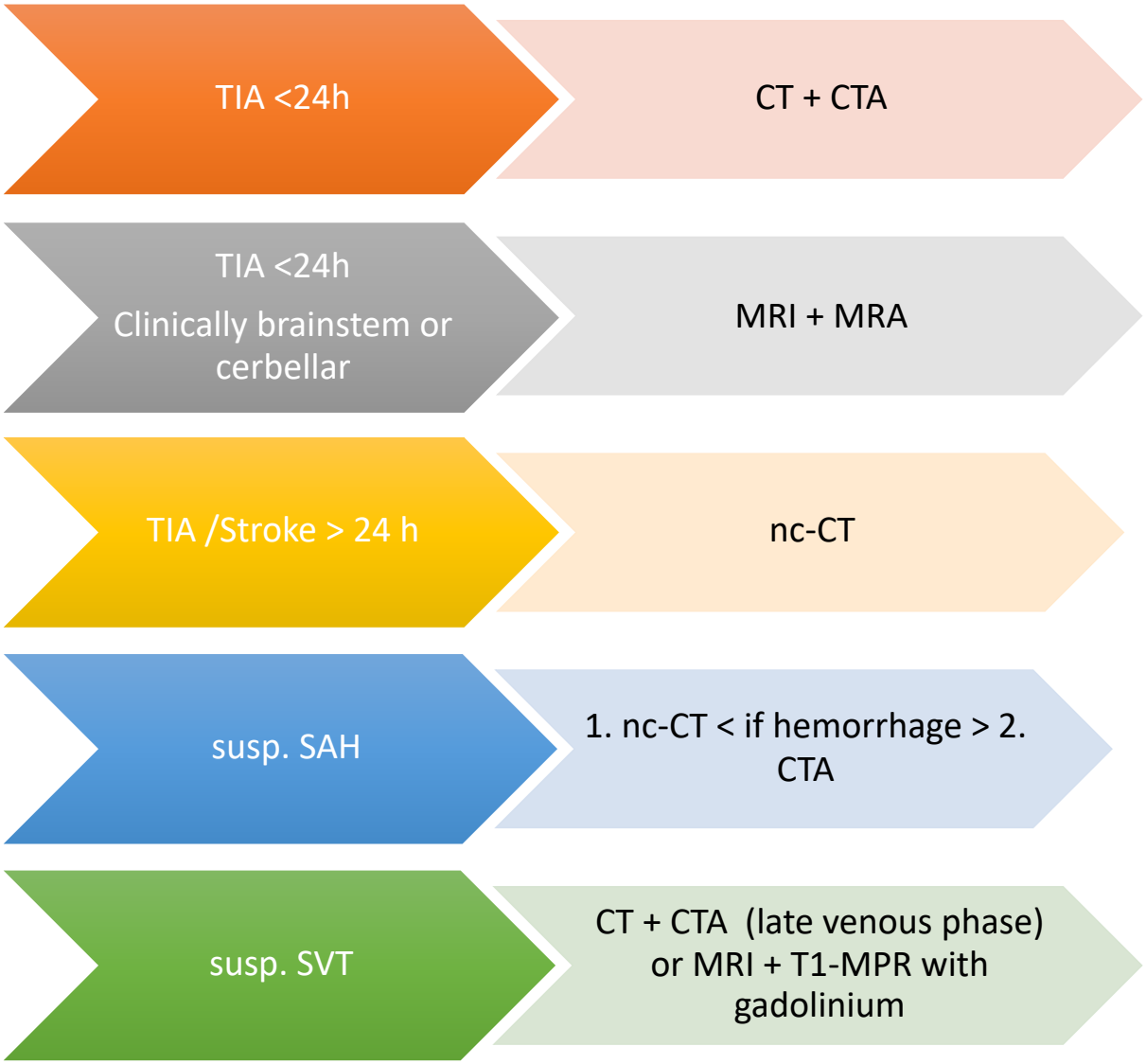


Wu TY, Coleman E, Wright SL, Mason DF, Reimers J, Duncan R, Griffiths M, Hurrell M, Dixon D, Weaver J, Meretoja A, Fink JN. Helsinki Stroke Model Is Transferrable With "Real-World" Resources and Reduced Stroke Thrombolysis Delay to 34 min in Christchurch. Front Neurol. 2018

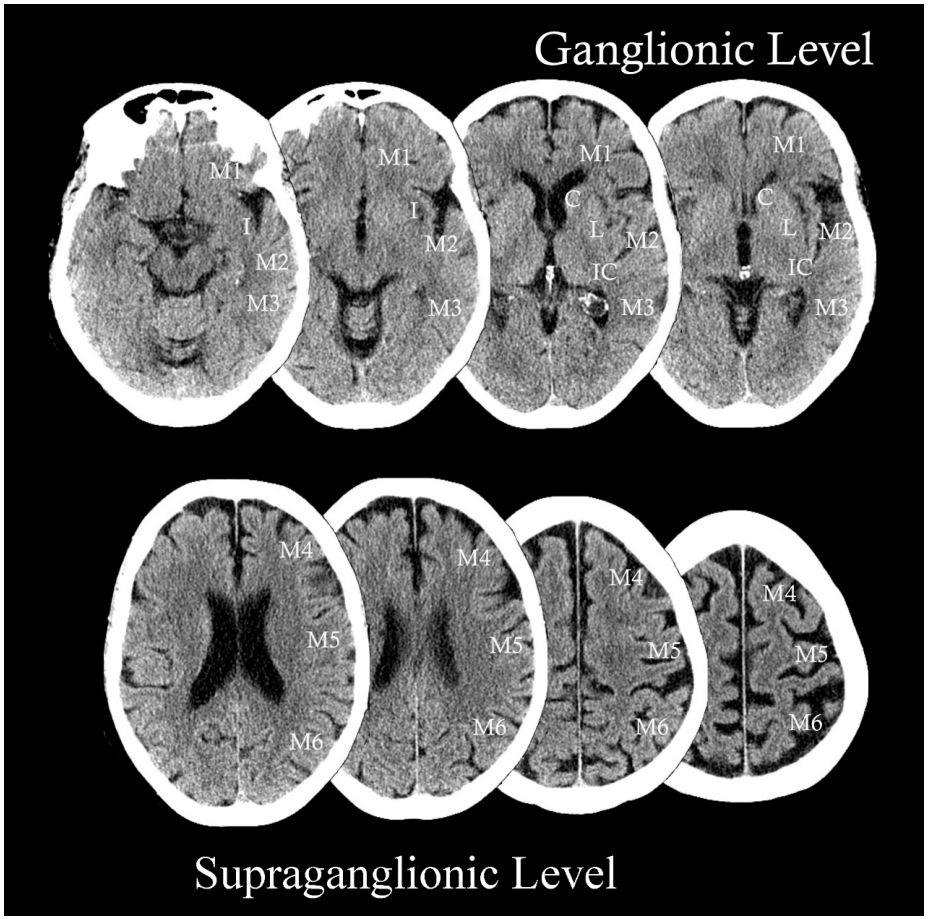
Stroke Imaging (1)



Stroke Imaging (2)



ASPECTS (Alberta Stroke Program Early CT Score
http://www.aspectsinstroke.com/

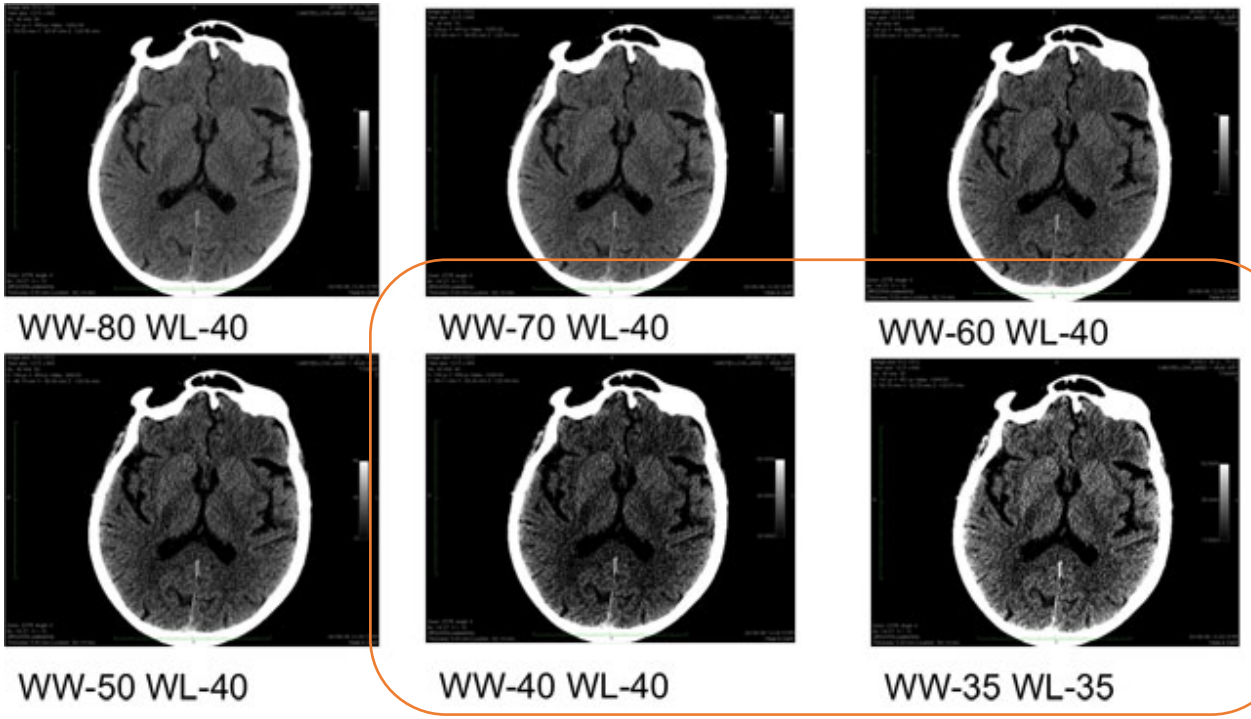


1. M1- Anterior MCAcortex
2. M2- MCA cortex lateral to the insular ribbon
3. M3- PosteriorMCA cortex,
4. M4, M5, M6 - anterior,
5. lateral and posterior
6. MCA territories rostral to basalganglia
7. C- Caudate
8. I- Insularribbon
9. IC- Internal Capsule
10. L-Lentiform nucleus

Score 10 = Normal Scan
Score 0 = Complete MCA territory involved

ASPECTS Score Window settings

Standard



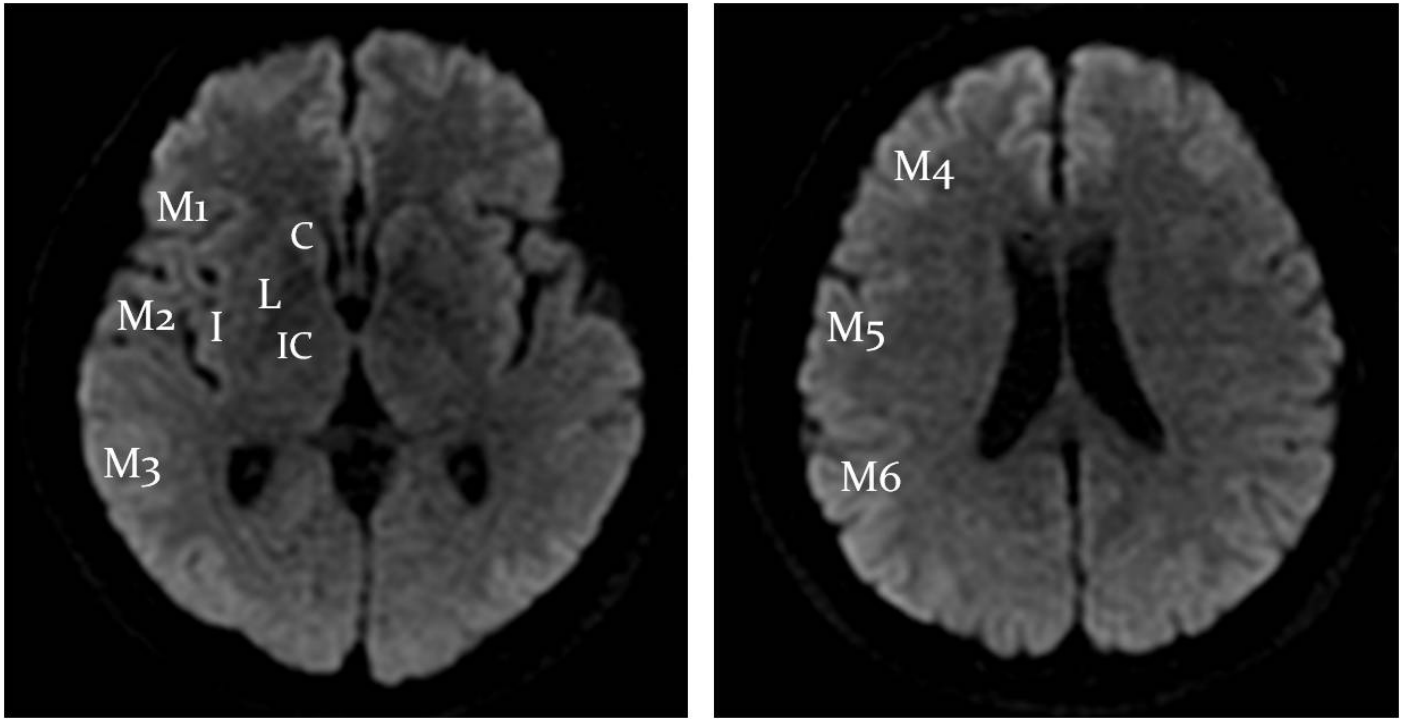
ASPECTS score as inclusion criterion in endovascular trials

ASPECTS	In	Out
IMS III	10-4	<4
ESCAPE	10-6	<6
SWIFT PRIME	10-6	<6

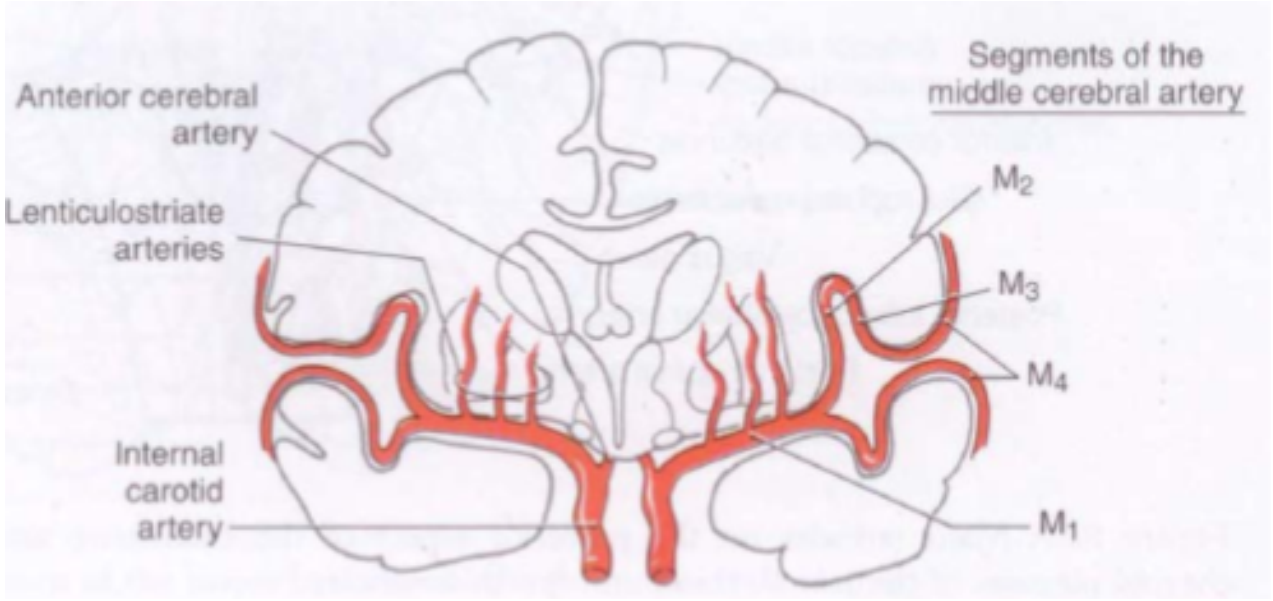
ASPECTS score limitations

- Only MCA
- Acute on chronic infarct
- WML
- Skull artifacts
- Watershed infarcts

DWI ASPECTS



Segments of the MCA



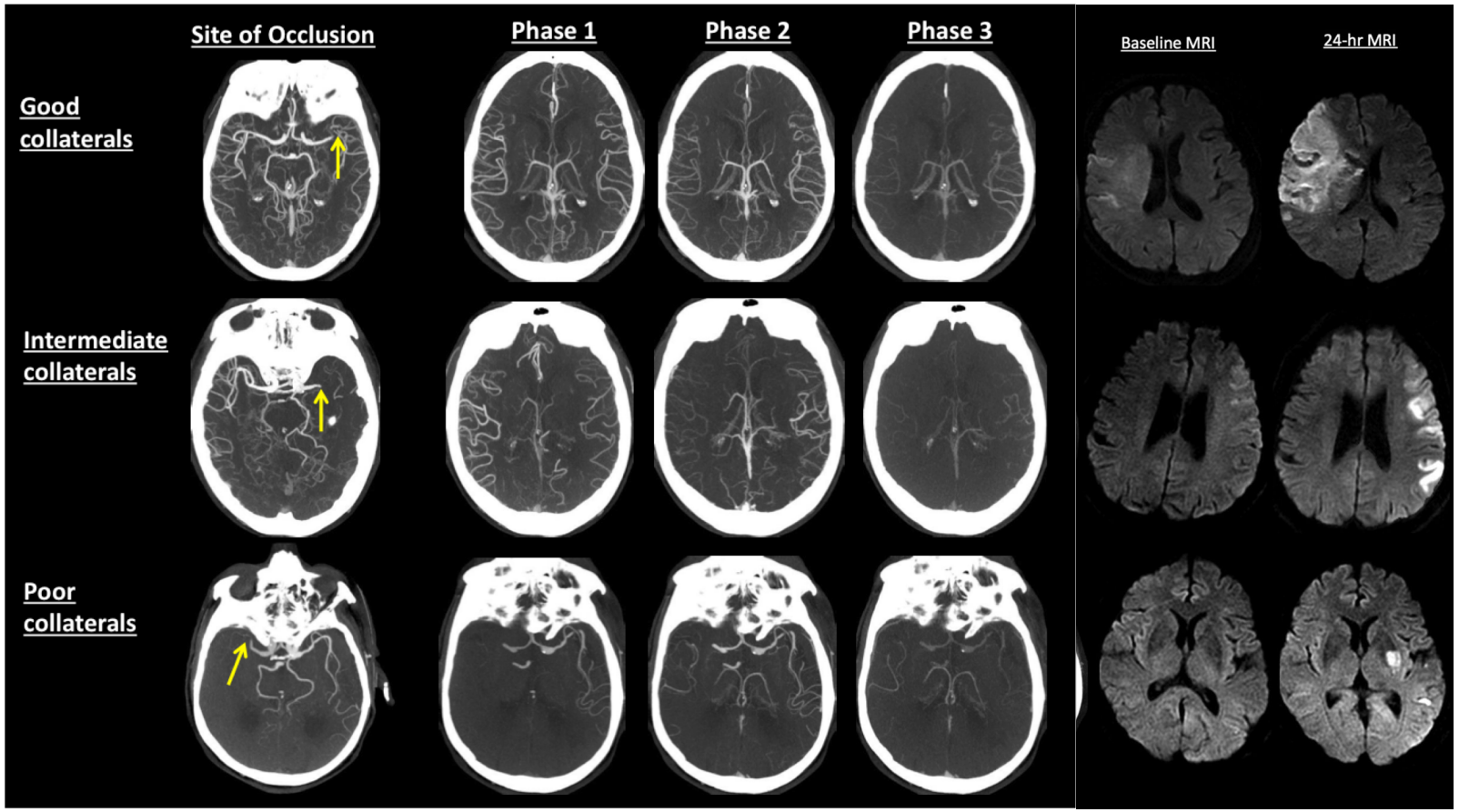
M1 und M2:The initial horizontal segment of the middle cerebral artery before bifurcation and the Sylvian fissure is termed M1, and the post-bifurcation segment in the Sylvian fissure is termed M2" Davis, Stephen et al Lancet Neurol 2015

M3: opercular segment

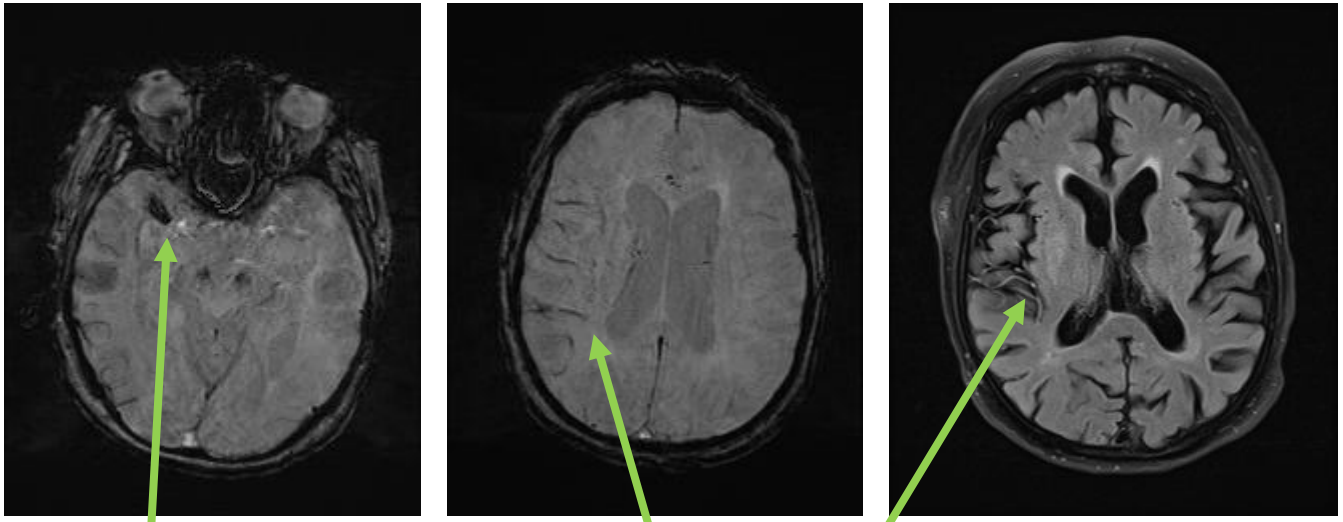
M4: cortical branches

Assessment of collaterals

- **Gold Standar**d: DSA
- **Dynamic CTA : good alternative**
- **zB. ASPECTS on Collaterals**



Assessment of collaterals



SOPs - Example : Thrombectomy for AIS (up to 6h)

Inclusion criteria:

Acute ischemic stroke

Time window

Anterior circulation: 4.5h to iv-thrombolysis, 6h to groin puncture.

Posterior circulation: Up to 6 hours (12 hours in some cases) to groin puncture (12h if the patient is comatose for less than 6 hours at the beginning of the Lysis and has no signs of irreversible brain stem damage)

Age, pre stroke impairment

No absolute age limits, ideally pre-mRS 0-2

Proven LVO

Distal ACI/Carotis-T

M1

proximal M2

Tandem stenosis – extracranial ACI + intracranial pathology

AB

If CTA/MRA impossible

NIHSS ≥ 9 within 3h, ≥ 7 within 3-6h after onset indicates LVO – consider DSA

Diffusion/perfusion mismatch and collateral status in CBV mapping can be included in decision-making (unclear time window/wake up stroke, onset of symptoms > 4.5h)

ASPECTS score ≥ 5

Exclusion criteria:

ASPECTS score 0-4 (relative, individual therapy decision)

BP > 185/110mmHg

Pre stroke mRS (3)/4/5 (relative)

Any type of acute hemorrhage in CCT/MRI

Time window -4.5h:

No CI vs. iv-lysis: Instant onset with iv-lysis at standard dosage 0.9mg/kg KG, max 90mg, 10% bolus

Already in CT room: If immediate intervention is possible

At Stroke Unit: If intervention has to be organised first

CI vs. iv-Lysis: Thrombectomy as first-line therapy

Patients with OAK:

INR > 1.7 – thrombectomy

INR-1.7 – bridging lysis, then thrombectomy

NOAKs: -thrombectomy

Time window 4.5-6h:

Thrombectomy without bridging as a first-line therapy or if significant perfusion-diffusion mismatch present > bridging lysis before thrombectomy

SOP Example: Wake Up Stroke

Definition:

Stroke with perception of symptoms upon awakening from sleep or with unclear and unobserved symptom onset

Time Limits:

Last seen symptom-free > 4,5h

Time from first perception of symptoms to potential rtPA application < 4,5h

Imaging

If possible: Multimodal MRI with DWI, Perfusion and MR angiography

Alternative: CT + CTA: No Early Signs, no LVO in the CTA

Infarct Size < + 3 MCA, < 1/2 ACA or PCA

No or only limited demarcation of the Infarction in the FLAIR sequence

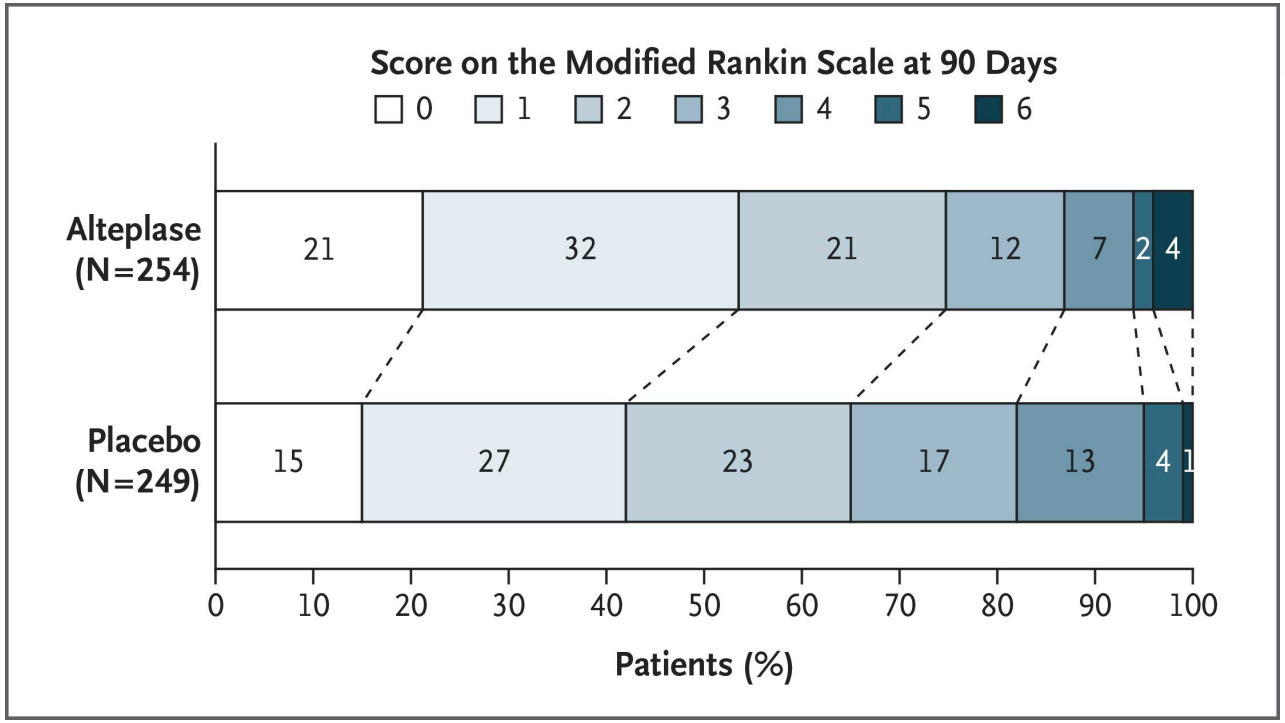
In case of Large Vessel Occlusion (LVO ICA or M1): Thrombectomy without bridging thrombolysis

Documented Patient consent

Apart from the time criterion, all contraindications apply as in thrombolysis in the regular timeframe

Processing of iv-thrombolysis as with standard IVT

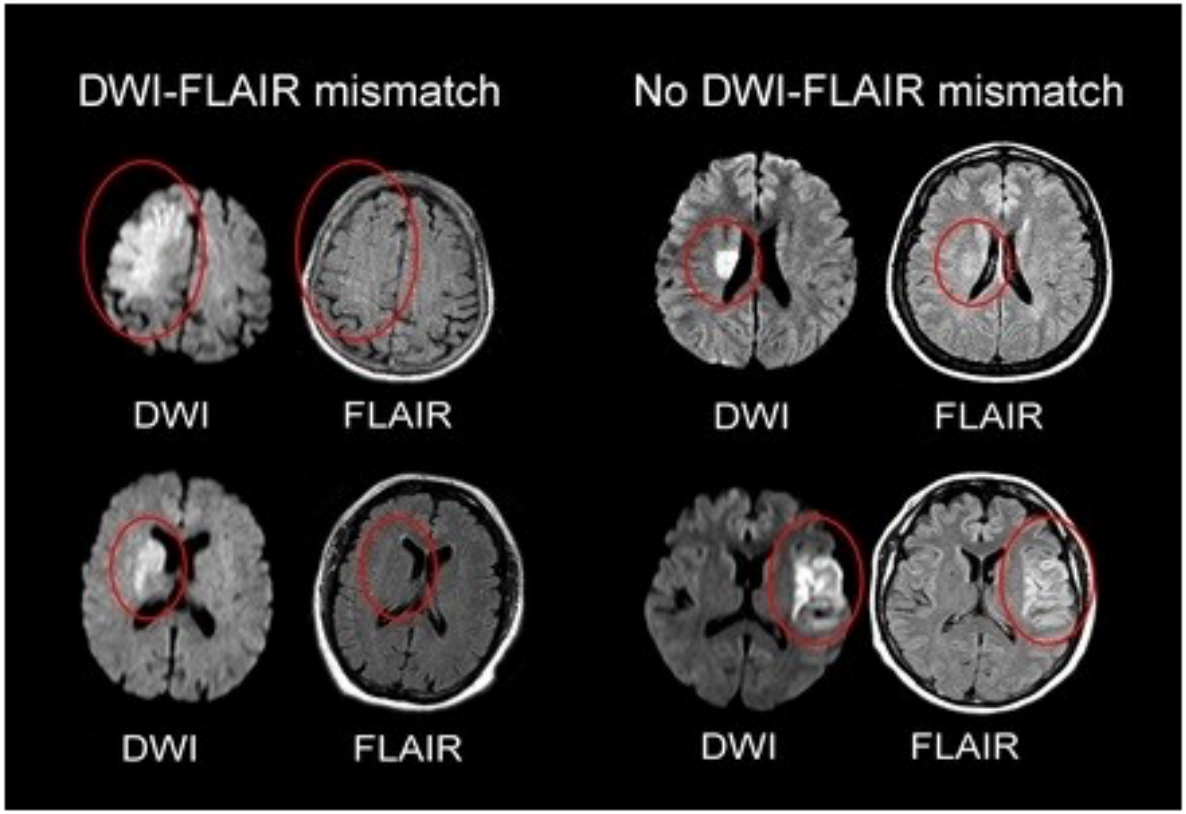
WAKE-UP Trial Results



Distribution of Scores on the Modified Rankin Scale at 90 Days (Intention-to-Treat Population).
-11% mRS 0-1 , NNT 9

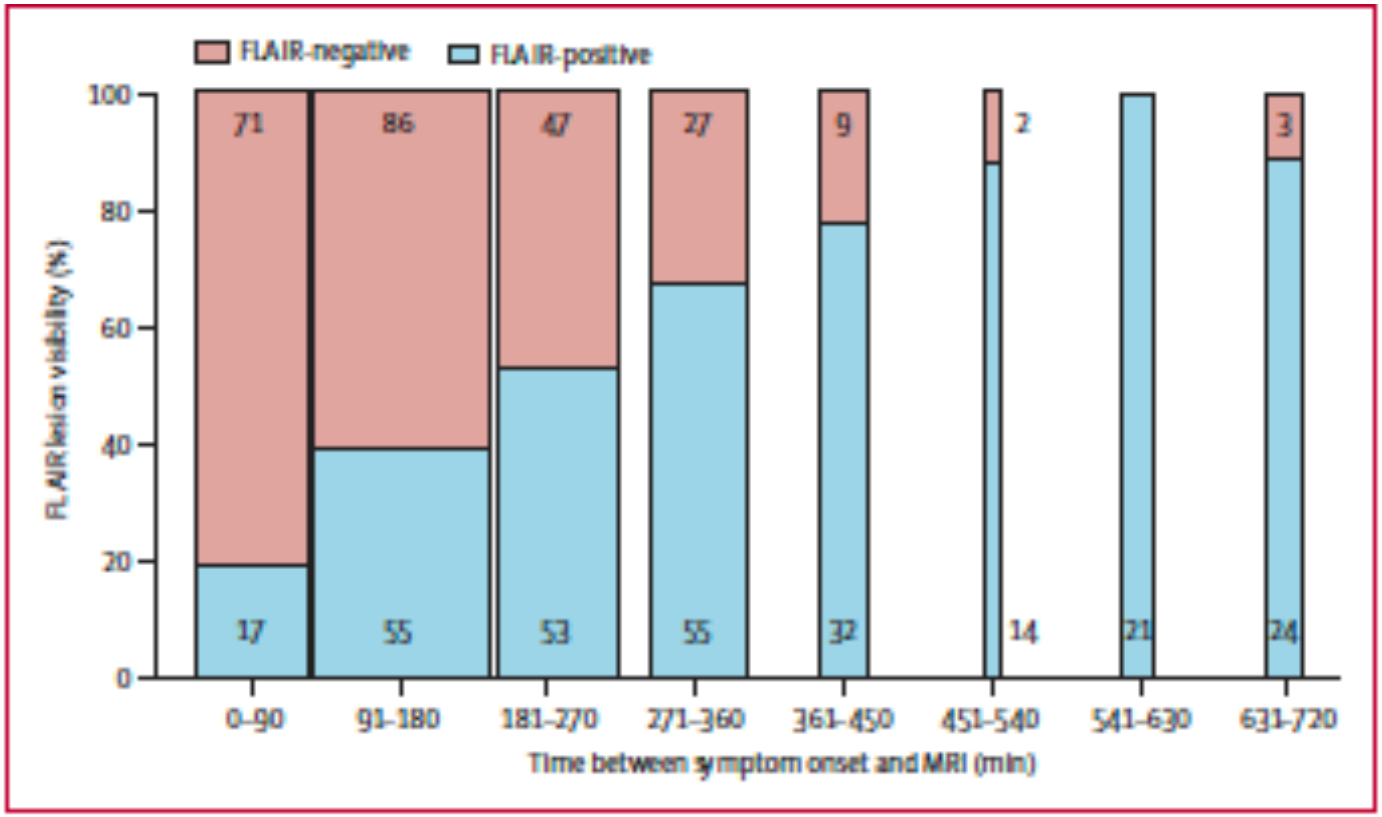
Thomalla G et al. N Engl J Med 2018;379:611-622

„Tissue Clock“ DWI – FLAIR mismatch



Evaluation of DWI-FLAIR mismatch paradigm PREFLAIR

N=543 1,5T oder 3T



Thomalla G, et al, Lancet Neurol 2011

SOP Example Thrombolysis under OAC

VKA: thrombolysis possible at INR <1.7

NOAK:

1) Intake of NOAC within the last 48 Hours excluded + normal global hemostasis > perform thrombolysis

2) Intake of NOAC within the last 48 hours is possible or propable:

iv-Lyse is possible, if

Dabigatran: Immediately after antagonization with Idaruzicumab (Praxbind): 2x 2.5 g/50 ml), intravenous as two consecutive Infusions over 5 to 10 minutes each

Apixaban, Rivaroxaban, Edoxaban: Anti Xa-activity is below detection Limit (< 0.1 U/l Xa Activity)

Acute care at stroke unit

1. SUs a re treatment facilities that save lives

2. Are educating facilities to improve knowledge and skills about stroke care

3. Are research facilities to perform clinical trials and observational studies

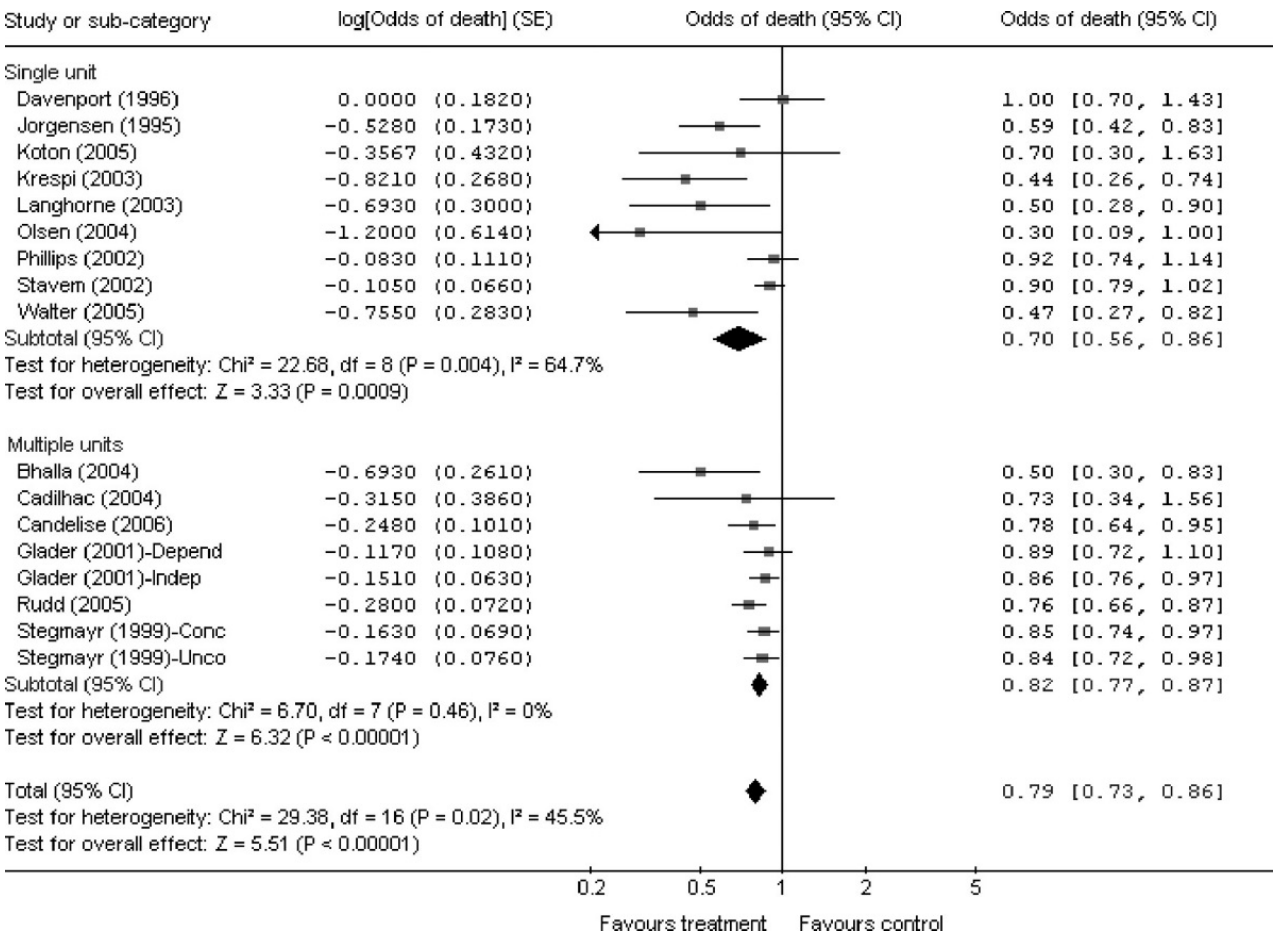
Stroke Units

Absolute outcomes (at 6-12 months)

Outcome	Stroke unit	Control	ARR
Home (independent)	44%	38%	+5%
Home (dependent)	16%	16%	0%
Institutional care	18%	20%	- 2%
Dead	22%	26%	-3%

Stroke Unit Trialists`Collaboration (2002)

Death within 1 year of stroke: stroke unit vs non-stroke unit care



Basic requirements for Austrian Stroke Units - Acute Type SU

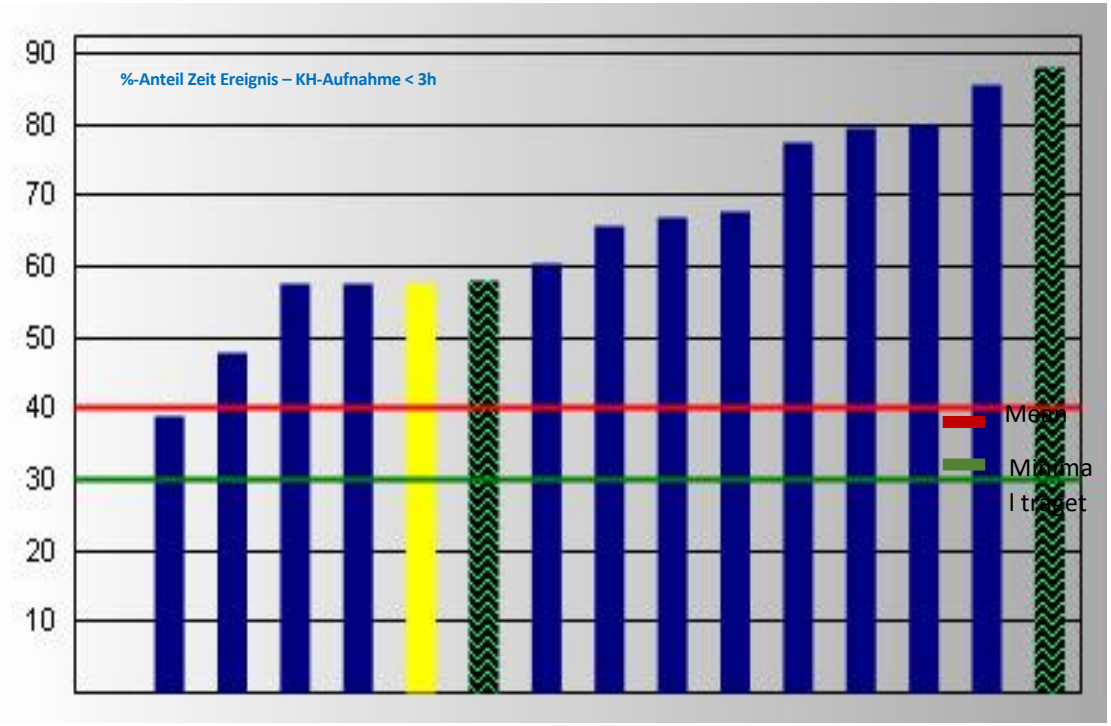
- Four to eight beds within an area that is exclusively for stroke patients within a department of neurology.
- Board-certified neurologist as responsible physician
- One neurologist in training present for 24 h
- Internist available or at least on call 24 h
- Nurses ratio of 1.0 nurse/bed min.
- At least one physiotherapist, one occupational therapist, and one speech therapist
- Continuous registration of electrocardiograph (ECG) and vital parameters (pulse rate, blood pressure, breathing pattern, oxygen saturation)
- Duplex sonography and transcranial doppler monitoring
- Computed tomography (CT) must be readily available 24 h
- Magnetic resonance imaging at least during the day time
- Intensive care unit must be available within the same hospital
- Neurosurgery must be available within 30 min.
- Digital subtraction angiography must be available within 30 min

Steiner M , Brainin, M , EJN 2002

Quality control - SU Registry
Important benchmark indicators

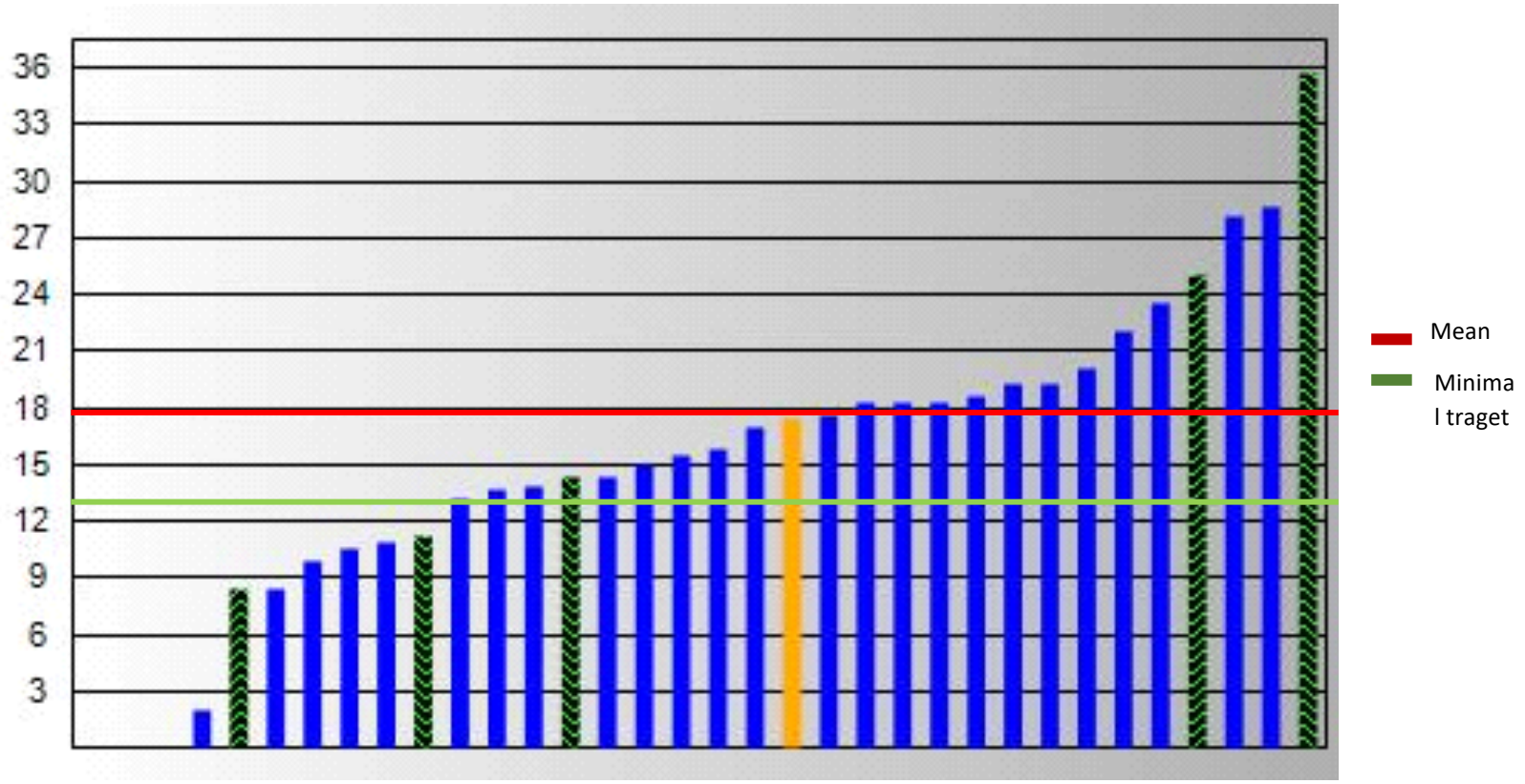
- Admissions to SU within 3 hours from onset
- First brain imaging within 1 hour
- Number of pts. Thrombolysed
- Number of selected pts. Thrombolysed
- Number of pts. With secondary prophylaxis at discharge

Example: % of pts. admitted within 3 h



Austrian Stroke Unit Registry, Steering Committee, unpublished

Example: Thrombolysis



Management and prevention of complications : dysphagia

- Stroke = most common cause of dysphagia
- dyspahgia pccurs in 42%-67% within the first 3 days after stroke (Joundi 2017, Gondzales-Fernandez 2013.Martino 2005)
- 5%-10% of all stroke patients develop pneumonia
- 37%-55% of dysphagia pat. develop pneumonia (Bray 2016, Hinchey 2005, Smith 2006, Martino 2005)
- Swallowing assessment after stroke is recommended in European, American and UK-Guidlines. (ESO 2008, American Heart Assiciation Stroke Council 2013, UK National Clinical Guidlines for stroke 2012)

Management and prevention of complications Dysphagia

GUGGING Swallowing Screen

- Freely downloadable
- www.donauuni.ac.at/imperia/md/images/department/kmp/publikationen/guss_e.pdf
- Validated and translated in many languages
- Recommended by NICE (Level 1b) and the German neurological Guidelines 2012

Patient´s label

G U S S
(Gugging Swallowing Screen)

Date:_____
Time:_____
Investigator:_____

1. Preliminary Investigation / Indirect Swallowing Test

		YES	NO
VIGILANCE	The patient must be alert for at least 15 minutes	1 ☐	0 ☐
COUGHING and/or THROAT CLEARING	Voluntary cough: The patient should cough or clear his/her throat twice	1 ☐	0 ☐
SWALLOWING SALIVA • Swallowing successful	Conduct oral hygiene if the mouth is very dry If the patient coughs during or after swallowing saliva please tick „No"	1 ☐	0 ☐
• Drooling	Permanent severe saliva drooling	0 ☐	1 ☐
• Voice change after swallowing	Gurgling, wet hoarse voice since onset of stroke	0 ☐	1 ☐
	SUM:		(5)
		1 – 4 = Stop the test see GUSS-Evaluation 5 = Continue with part 2	

2. Direct Swallowing Test (Material: Water, food thickener, teaspoon, cup, syringe, bread, biscuit)

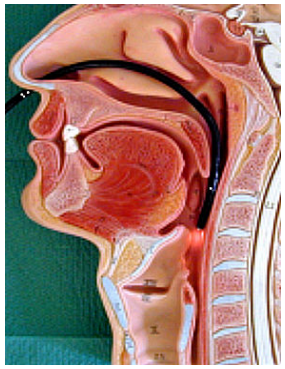
In the following order	SEMISOLID→	LIQUID→	SOLID
	½ teaspoon of thickened water (IDDSI: Level 3) If there are no symptoms apply 3-5 more teaspoons Stop the investigation if one of the 4 aspiration criteria is observed	Offer 3, 5, 10, 20 ml of water in a cup followed by 50 ml of water. (sequential swallow) Stop the investigation if one of the 4 aspiration criteria is observed	Offer a piece of bread without crust and/or a piece of biscuit (max. 1.5 x 1.5cm) Stop the investigation if one of the 4 aspiration criteria is observed
DEGLUTITION			
▪ Swallowing not possible	0 ☐	0 ☐	0 ☐
▪ Swallowing delayed (semisolids, fluids > 2 sec. solids > 10 sec.)	1 ☐	1 ☐	1 ☐
▪ Swallowing successful	2 ☐	2 ☐	2 ☐
COUGHING (involuntary) *(before, during and after swallowing - until 3 minutes later)*			
▪ Yes	0 ☐	0 ☐	0 ☐
▪ No	1 ☐	1 ☐	1 ☐
DROOLING			
▪ Yes	0 ☐	0 ☐	0 ☐
▪ No	1 ☐	1 ☐	1 ☐
VOICE CHANGE *(Listen to the voice before and after swallowing - Patient should say „Ohhh")*			
▪ Yes	0 ☐	0 ☐	0 ☐
▪ No	1 ☐	1 ☐	1 ☐
SUM:	(5)	(5)	(5)
	1 – 4 = Stop the test see GUSS-Evaluation 5 = Continue „Liquid"	1 – 4 = Stop the test see GUSS-Evaluation 5 = Continue „Solid"	
SUM: (Indirect Swallowing Test AND Direct Swallowing Test)		_____	(20)

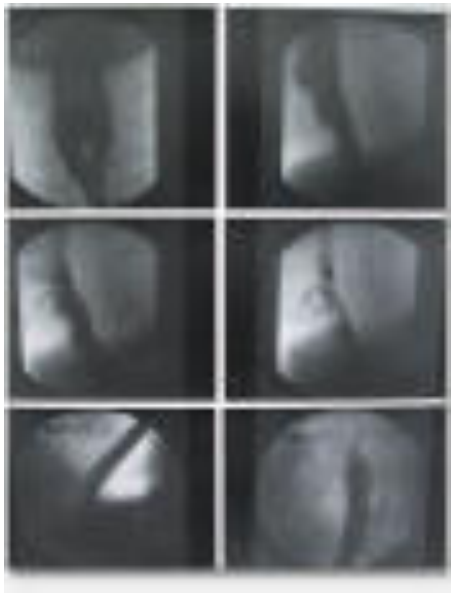
The Gugging Swallowing Screen. Stroke. 2007;38:2948 Michaela Trapl, SLT, MSc; Paul Enderle, MD, MSc; Monika Nowotny, MD; Yvonne Teuschl, PhD; Karl Matz, MD; Alexandra Dachenhausen; PhD Michael Brainin, MD

Trapl, Enderle , Nowotny, Matz , Teuschl , Dachenhausen Brainin, Stroke 2007

Management and prevention of complications Dysphagia

FEES





- DIAGNOSTICS
- Bedside screening process
- VFS (Videofluoroscopy)
- FEES (Fibre-optic endoscopy evaluation of swallowing)

When to screen for dysphagia

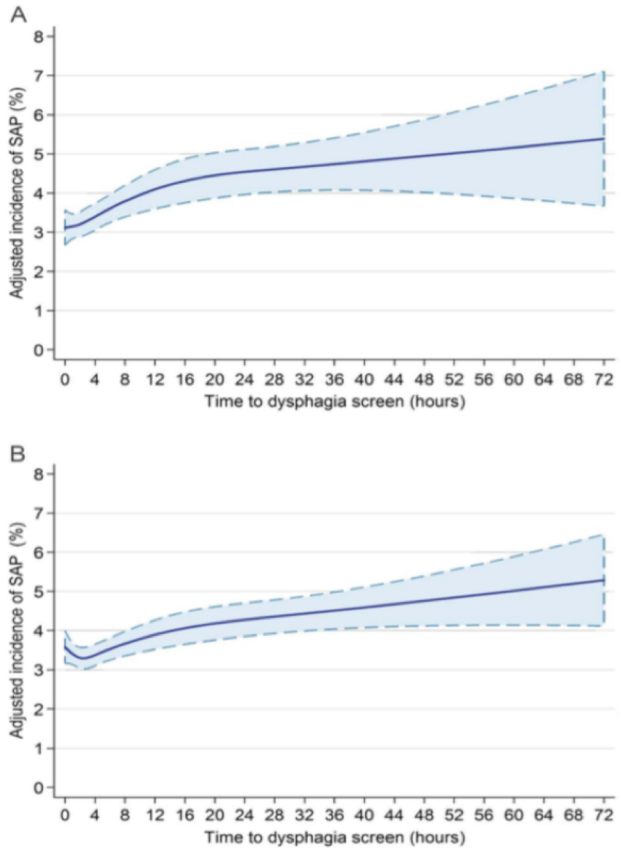


Figure 1 Modelled relationship between estimated incidence of SAP in the first 7 days of admission and time to dysphagia screening. (A) Multivariable model including NIHSS. (B) Multivariable model including level on consciousness. NIHSS, NIH Stroke Scale; SAP, stroke-associated pneumonia.

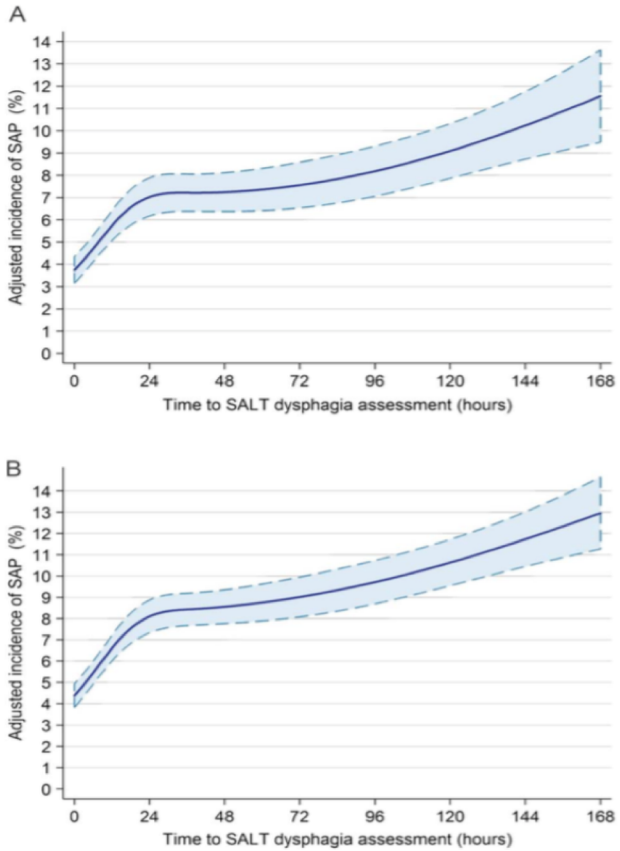
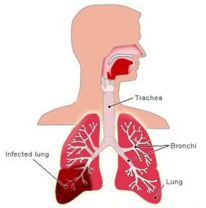
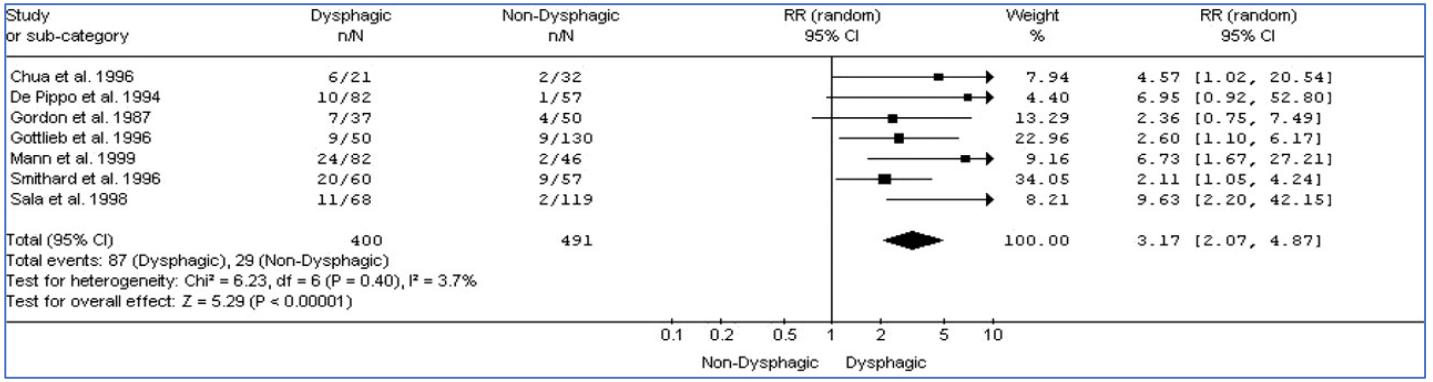


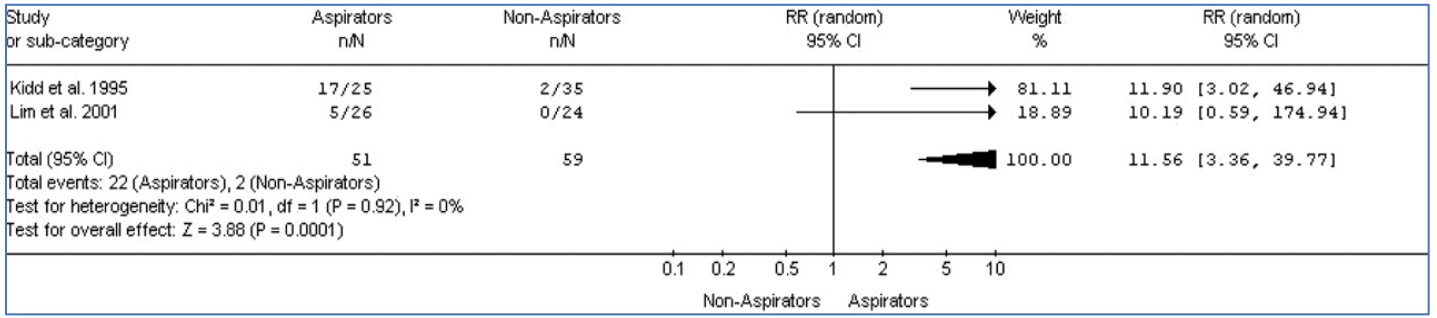
Figure 2 Modelled relationship between estimated incidence of SAP in the first 7 days of admission and the time to SALT dysphagia assessment. (A) Multivariable model including NIHSS. (B) Multivariable model including level on consciousness. NIHSS, NIH Stroke Scale; SALT, speech and language therapist; SAP, stroke-associated pneumonia.

J Neurol Neurosurg Psychiatry. 2016 Jun 13. pii: jnnp-2016-313356. doi:10.1136/jnnp-2016-313356. [Epub ahead of print] **The association between delays in screening for and assessing dysphagia after acute stroke, and the risk of stroke-associated pneumonia**. Bray BD et al.

Dysphagia and Aspiration

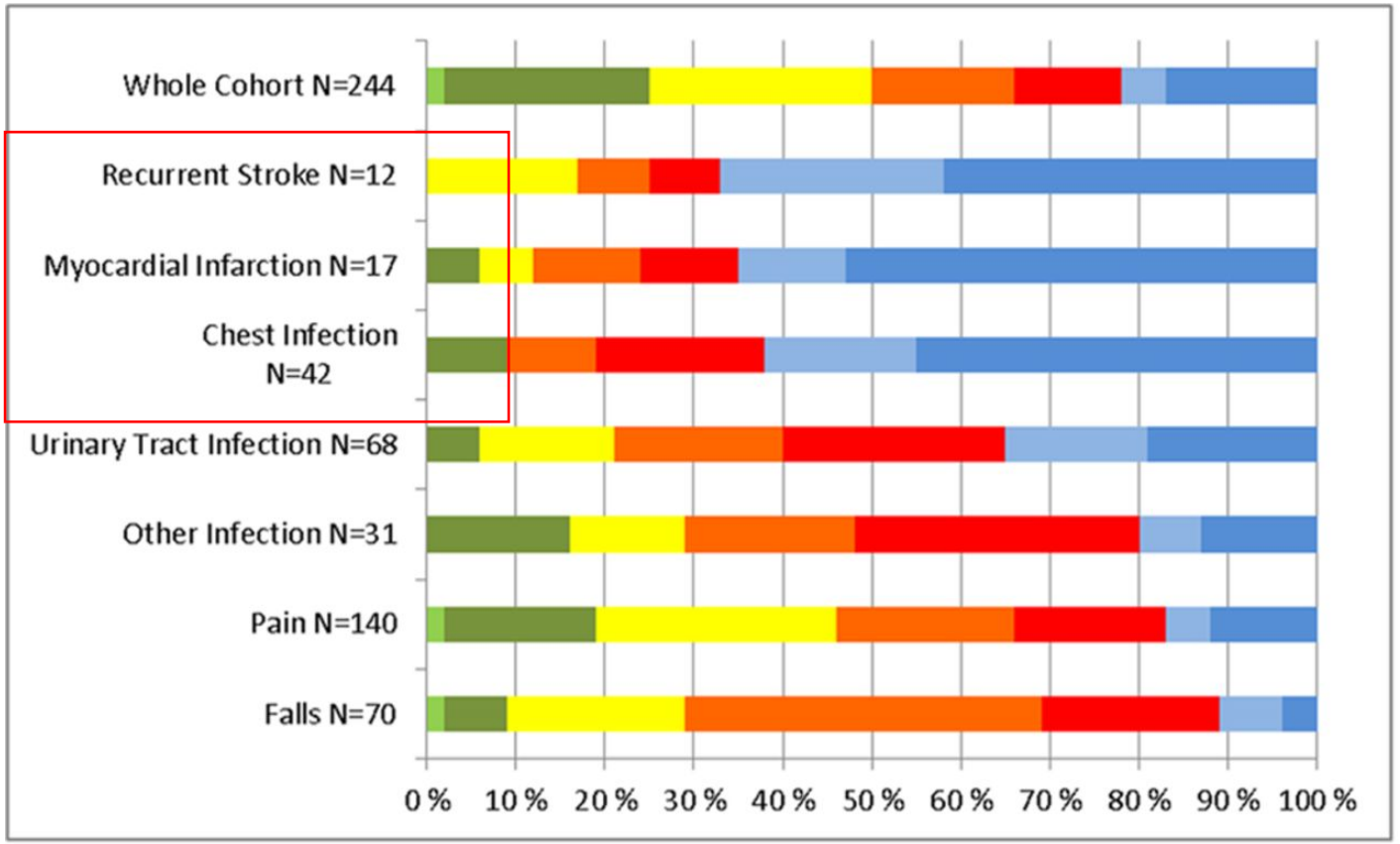






Martino, R. et al. Stroke 2005;36:2756-2763

Distribution of modified Rankin Scale (mRS) scores at 90 days

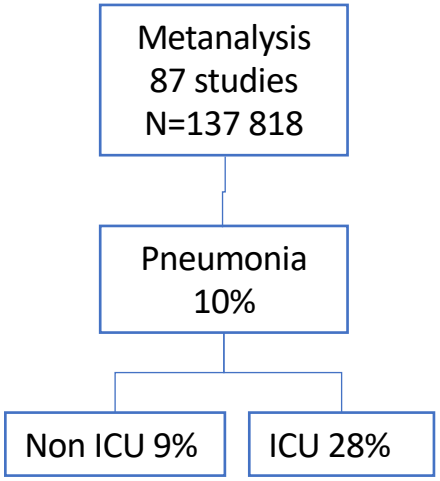


mRS 0=light green, 1=dark green, 2=yellow, 3=orange, 4=red, 5=light blue, 6=dark blue

Gitta Rohweder et al. Stroke. 2015;46:65-70

Management and prevention of complications : Pneumonia
Prevalence of stroke associated pneumonia (SAP)

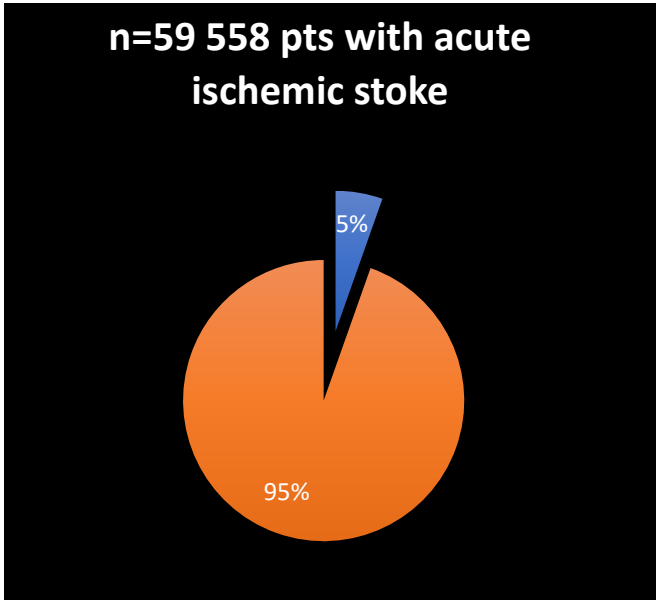
Author	N	Study type	Prevalence
Tischwell et al J Stroke Cerbrovasc dis 1999	4757	Stroke registry	7%
Weimar et al Eur Neur 2002	3866	Stroke registry	7%
Johnston et al Stroke 1998	279	RCT	10%
Aslanyan et al Eur Neurol 2004	1455	RCT	14%
Hilker et al Stroke 2003	151	ICU registry	21%
Walter et al J Neurol 2007	236	ICU registry	22%
Kasua et al J Crit care 2010	111	ICU registry, art. ventilated	28%

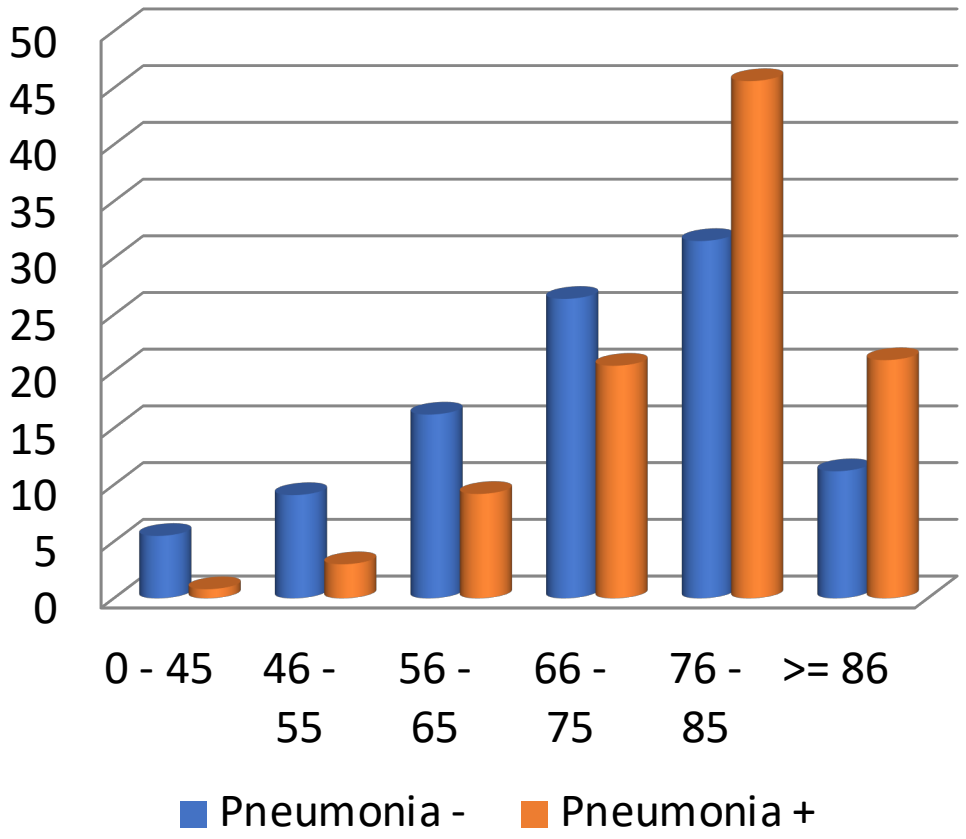


Westendorp etaal, BMC Neurol 2011

Prevalence of SAP and age distribution of pts with & without SAP

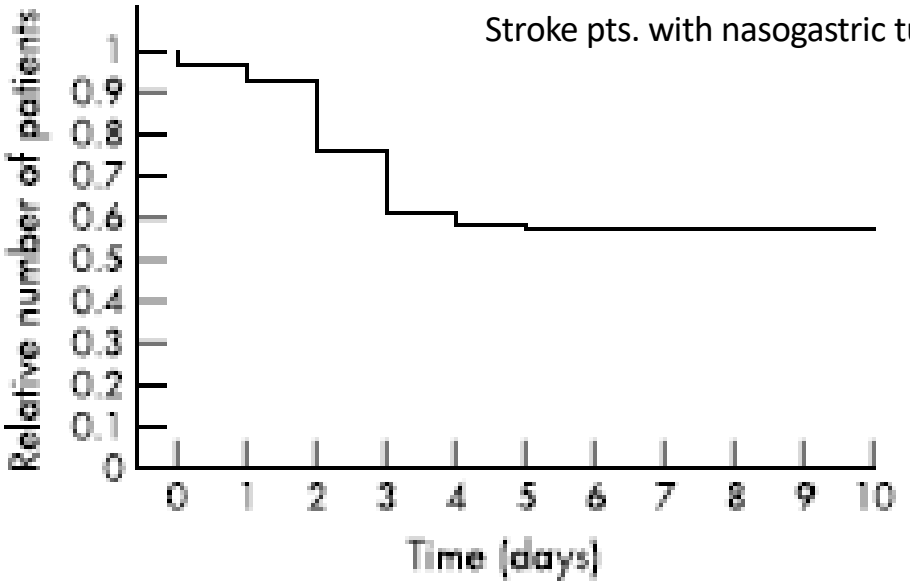
Austrian Stroke Unit Registry 2003 to 2013





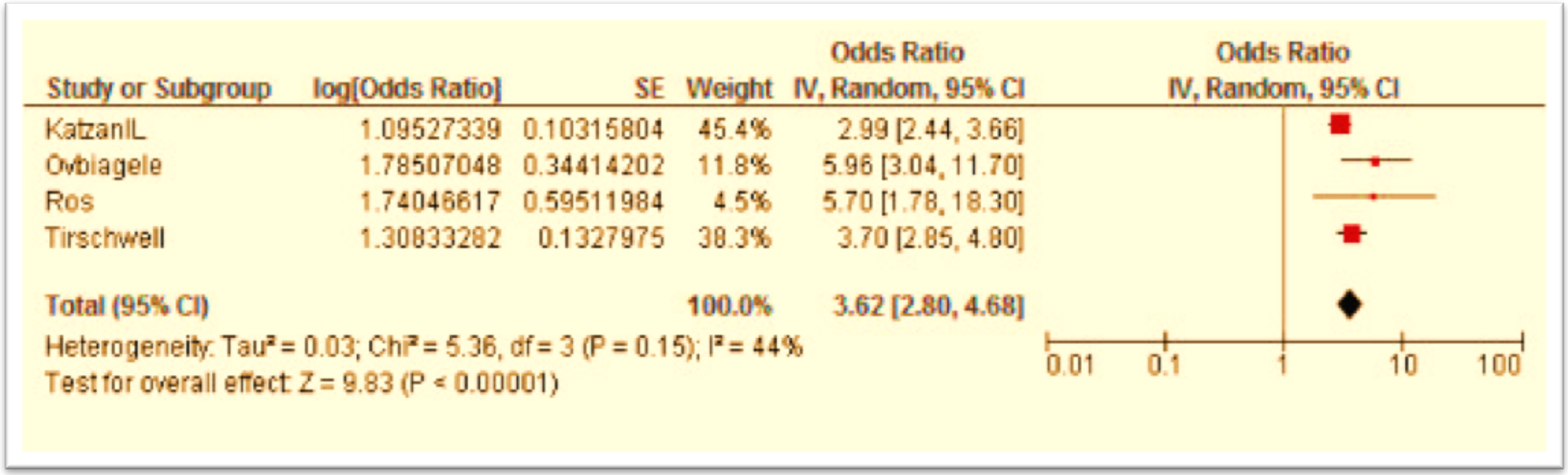
Matz K etal, BMC Neurol 2017

SAP usually develops in the first days



Dziewas R et al JNNP 2004

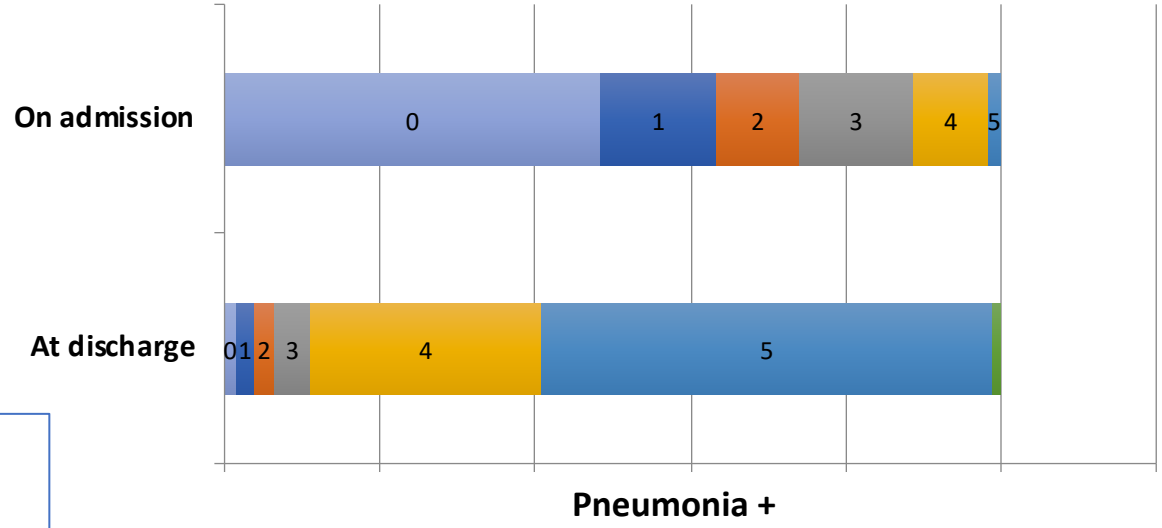
SAP and In-hospital mortality



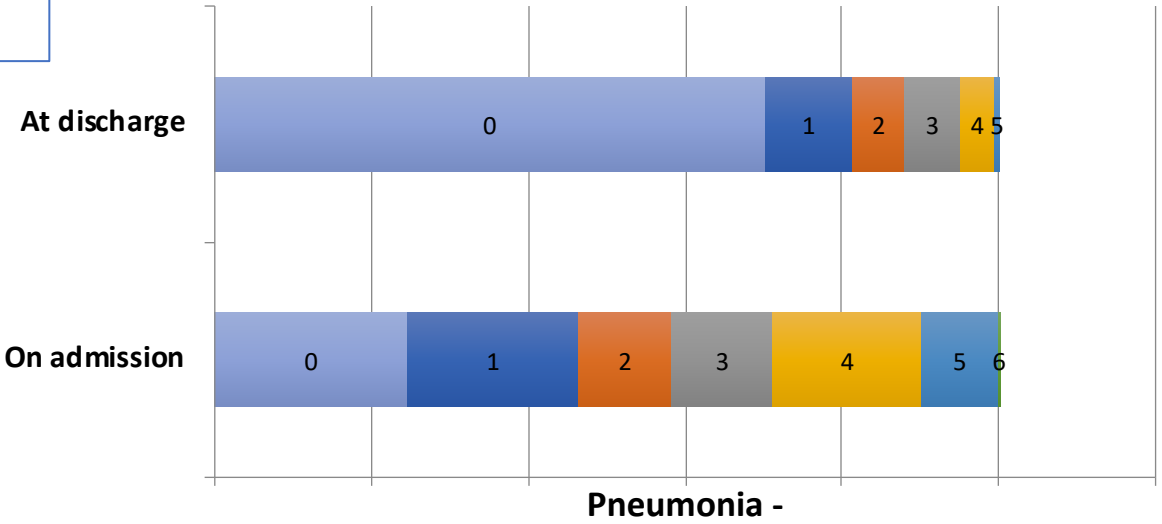
Pooled studies with corrected ORs, random effect model

Westendorp et al , BMC Neurol 2011

mRS on admission and at discharge from SU



3 months mortality
42.1% vs. 7.5%,
p<0.001, OR 2.99,



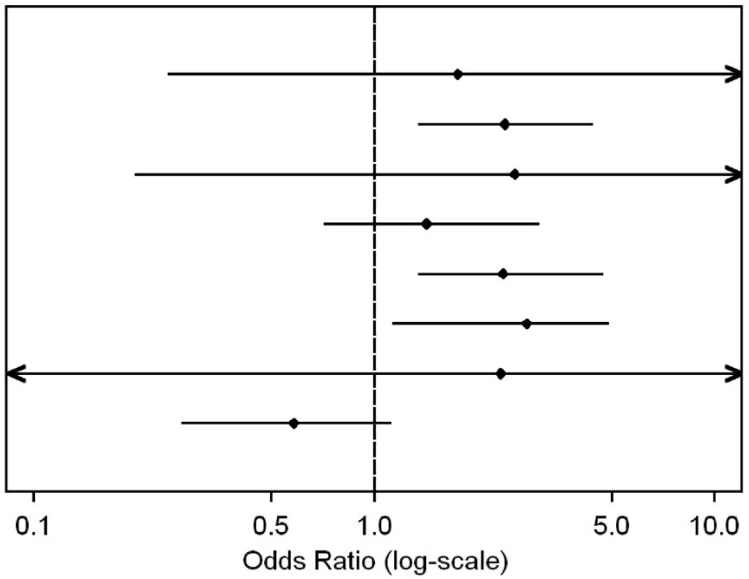
Risk factors for SAP

- Stroke severity
- Age
- Dysphagia
- Dysarthria
- Altered level of consciousness
- Artificial ventilation
- Chronic lung disease
- Hemorrhagic transformation of infarct
- Non-lacunar basal-ganglia infarction
- Use of PPIs

- Smithhard DG et al Stroke 1996, Johnston KC Stroke 1998, Hilker et al Stroke 2003, Walter J Neurol 2007, Sellar et al Stroke 2007, Kasua et al J Crit Care 2010, Kunar S et al Lancet Neurol 2010

Frequency of intervention use in stroke units and conventional care

Intervention	Number of events: stroke unit (%)	Number of events: control (%)
Antibiotics	109 (36.6)	75 (24.5)
Aspiration prevention	44 (28.9)	22 (14.5)
Fluids	473 (76.5)	319 (48.4)
Insulin	46 (8.6)	34 (6.3)
Oxygen	185 (52.3)	120 (33.9)
Paracetamol	212 (37.9)	106 (18.7)
Tube feeding	58 (26.7)	27 (12.4)
Urinary Catheter	72 (21.1)	99 (29.3)



Lindsay Govan et al. Stroke. 2007;38:2536-2540

Complications at SUs vs. Non-SU care

Outcome/Category	No. of Events: Stroke Unit (%)	No. of Events: Control (%)	OR (median)	95% CrI
Neurological				
Anxiety or depression	112 (16.7)	132 (19.7)	0.74	(0.27–1.97)
Seizures	15 (2.7)	17 (3.1)	0.86	(0.37–1.95)
Stroke progression or recurrence*	85 (9.4)	121 (13.5)	0.66	(0.46–0.95)
Cardiovascular				
Cardiovascular†	83 (14.2)	66 (11.0)	1.52	(0.58–4.54)
Complications of immobility				
Chest infection	87 (12.0)	134 (18.6)	0.60	(0.42–0.87)
Other infections‡	122 (13.5)	201 (21.9)	0.56	(0.40–0.84)
Dehydration	21 (5.1)	43 (10.1)	0.81	(0.31–2.53)
Venous thromboembolism§	30 (4.4)	35 (5.0)	0.85	(0.49–1.49)
Falls	28 (18.4)	43 (28.3)	0.57	(0.33–0.97)
Pressure sores	21 (4.7)	43 (9.6)	0.44	(0.22–0.85)
Pain	70 (12.1)	71 (12.3)	0.73	(0.14–2.60)
Other complications				
Other	22 (2.9)	24 (3.1)	0.95	(0.46–2.10)

Govan L et al , Stroke 2007

Preventive measures

Selective orale decontamination

- On treatment pneumonia 1/103 pts. (1%) vs 10/100 pts. (10%) in controls , p=0.029

Goseney A et al, Age Ageing 2006

Metoclopramide for pts. with nasogastric tubes, n=60

- On treatment 73% Pneumonia free, Placebo 13%
- Risk Ratio 5.21, p=0.001

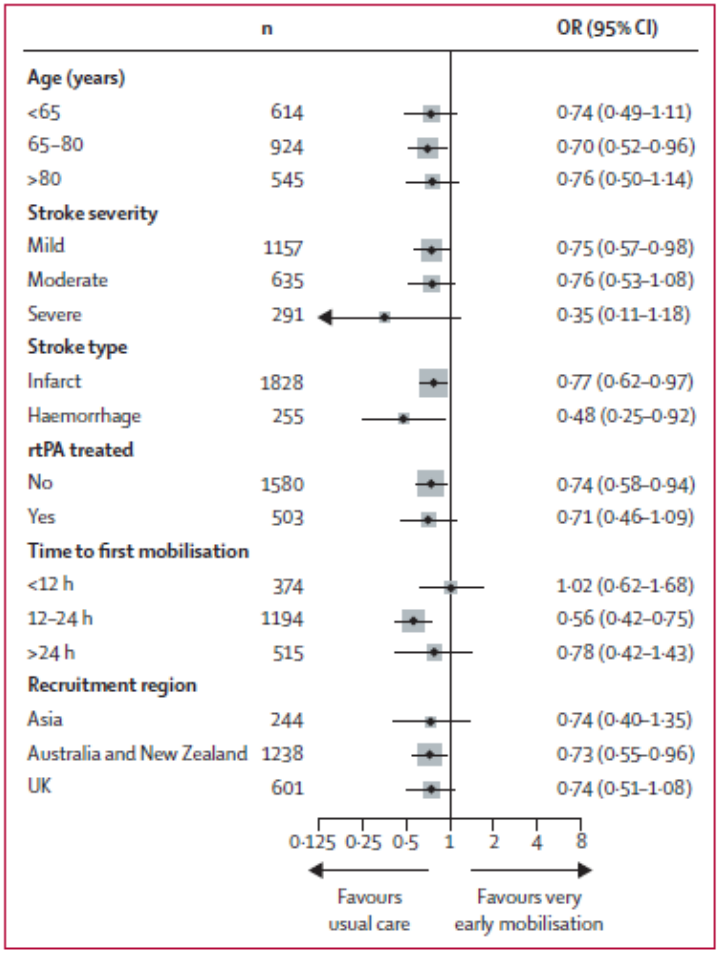
Warusevitane A et al, Stroke 2015

Other preventive measures

Early mobilisation

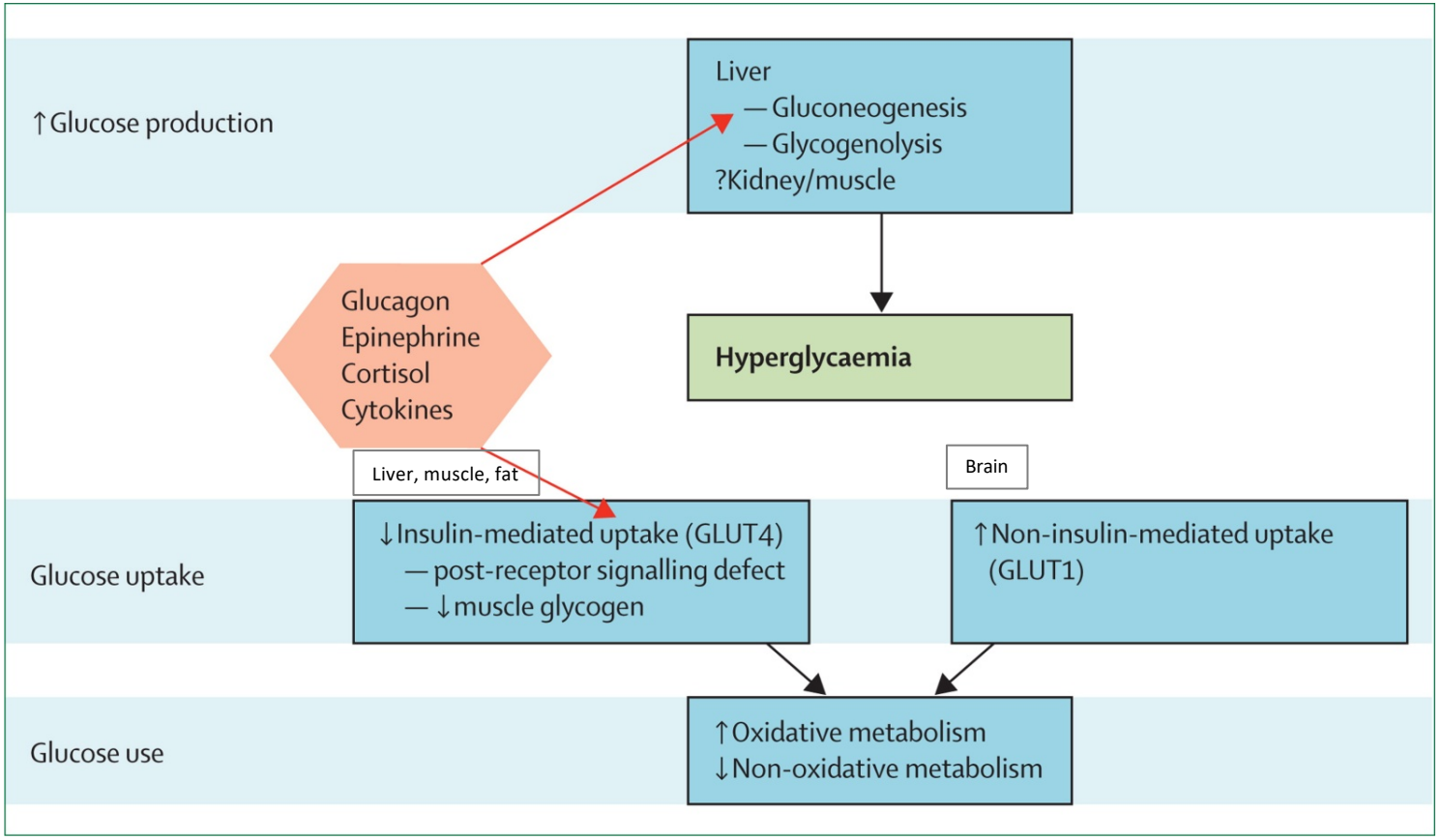
AVERT Trial

- Immobilisation associated complications (included PSP): 5% in both groups



Stress Hyperglycemia

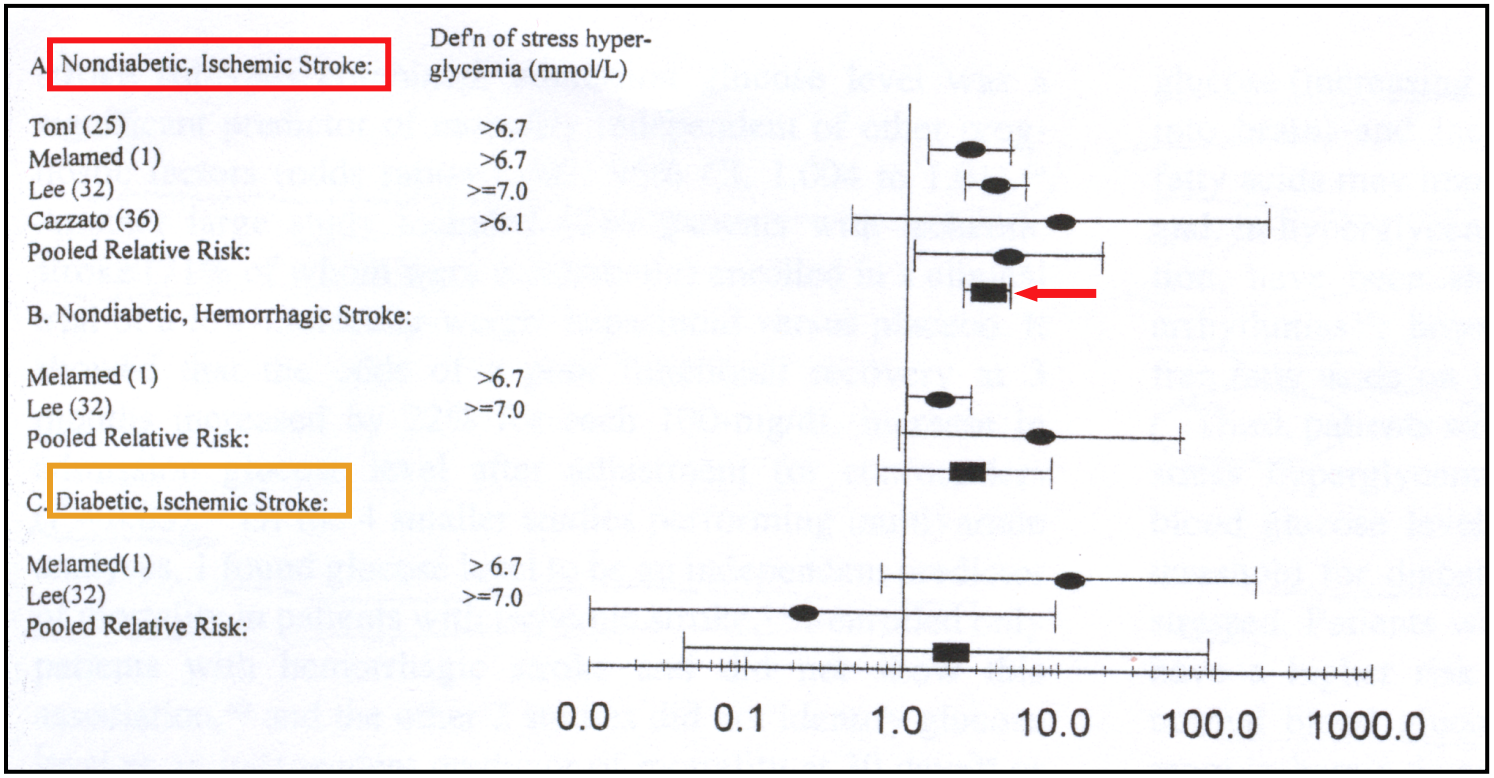
Fasting BG >6.9 mmol/l (124mg/dl) oder random BG > 11.1.mmol/l (200mg/dl)
ADA definition



Dungan Km, Braithwaite SS, Preiser J, Lancet 2009

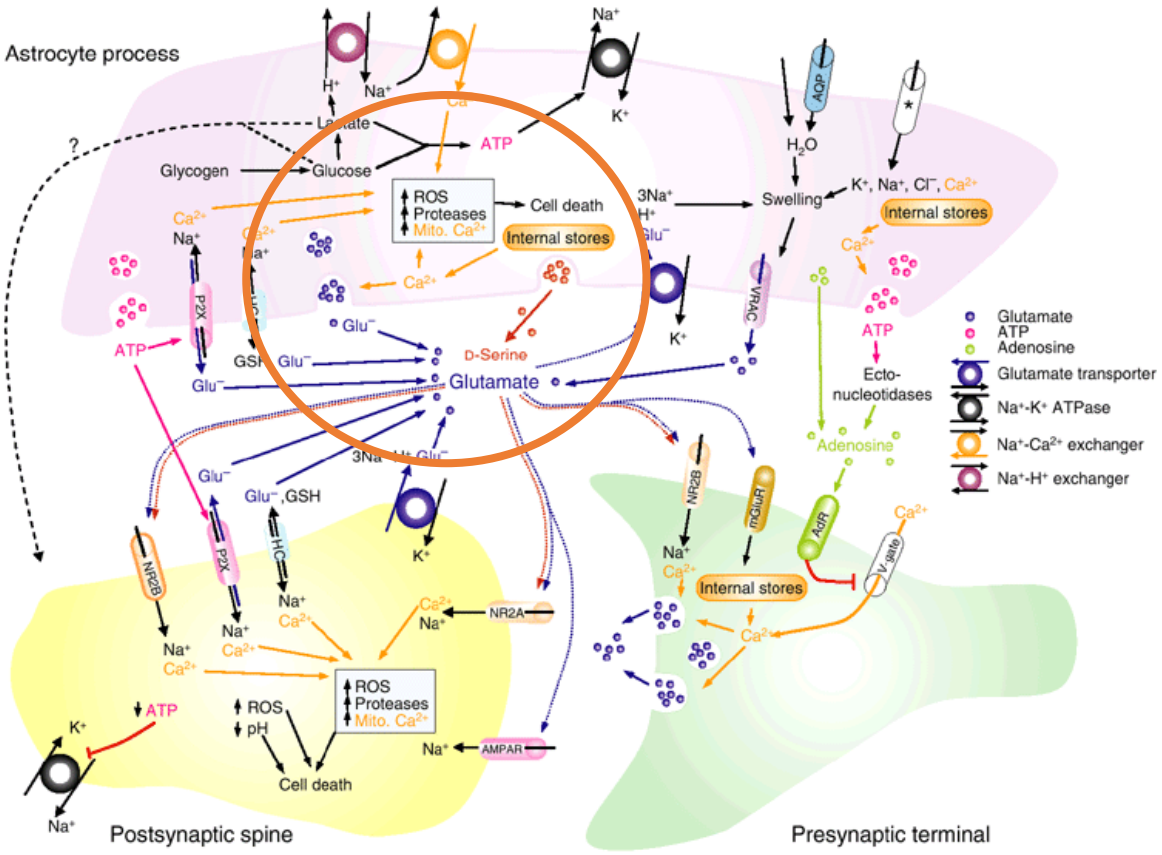
Hyperglycemia and stroke associated mortality

30 d-mortality



Sarah EC, Stroke 2001

Hyperglycemia and ischemic injury

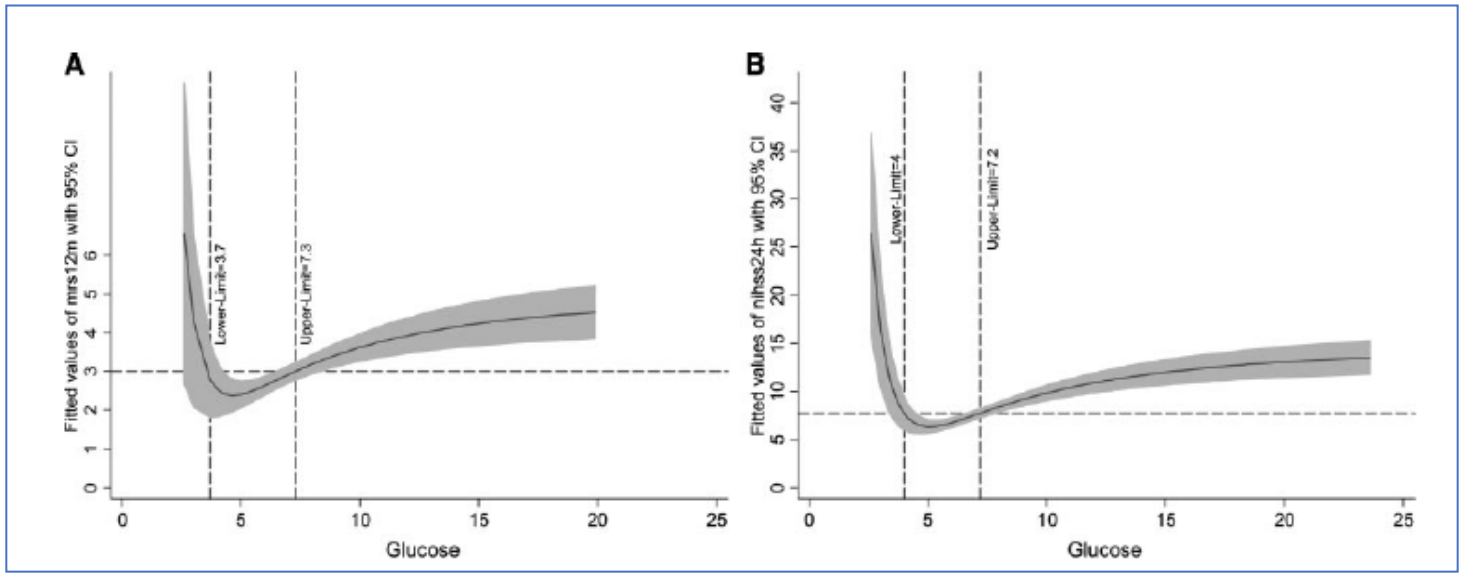


Rossi DJ et al ; Nat Neurosci 2007

Possible factors accounting for worse outcome of hyperglycemic stroke patients

Metabolic disturbance				**Outcome related effect**
Hyperglycemia	→	Extracellular lactate-acidosis	→	Neurotoxic cell damage
Hyperglycemia	→	Disruption of blood brain barrier	→	Intracranial hemorrhage with thrombolytic therapy
Diabetic vasculopathy	→	Atherosclerotic macro- and microangiopathy	→	Reduced tissue salvage by collateral flow
Diabetic vasculopathy	→	Instable atherosclerotic plaque	→	Recurrent stroke, concurrent myocardial infarction
Diabetic Immunopathy	→	Reduced immune response	→	Concurrent Infections

J shaped realtionship between glucose levels and stroke severity and outcome

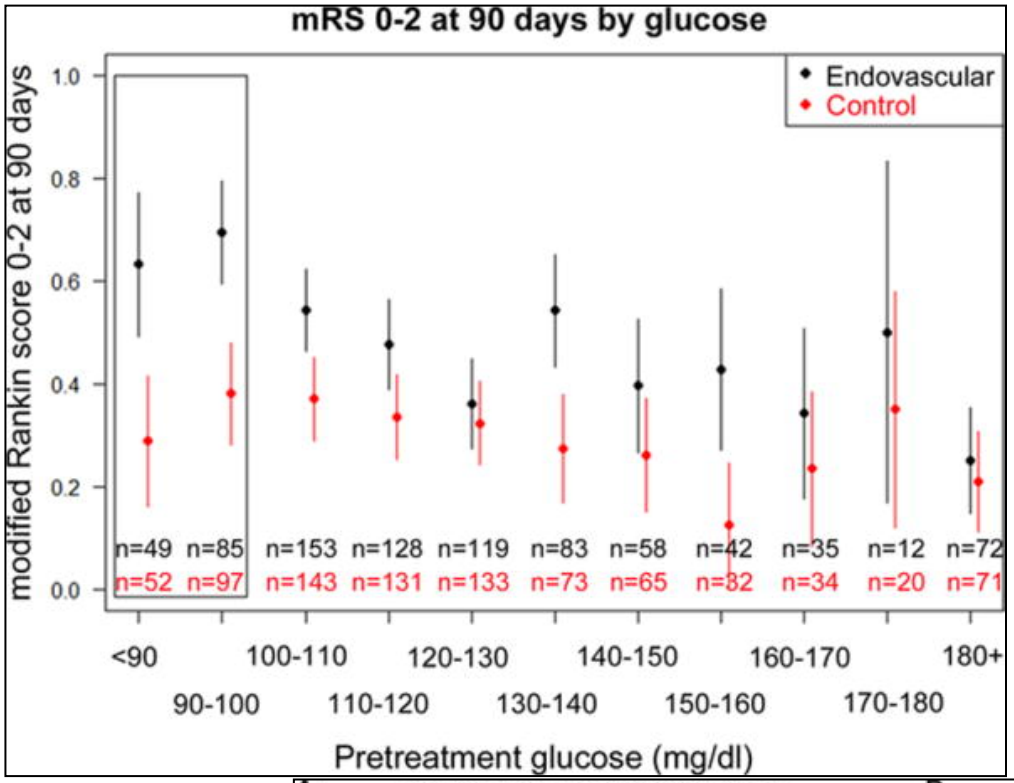


Favorable outcome between 3.7 and 7.3 mmol/l (67 – 133mg/dl)

Best 24h NIHSS between 4.0 and 7.2 mmol/l (72 – 130mg/dl)

Ntaios G et al. , Stroke 2010

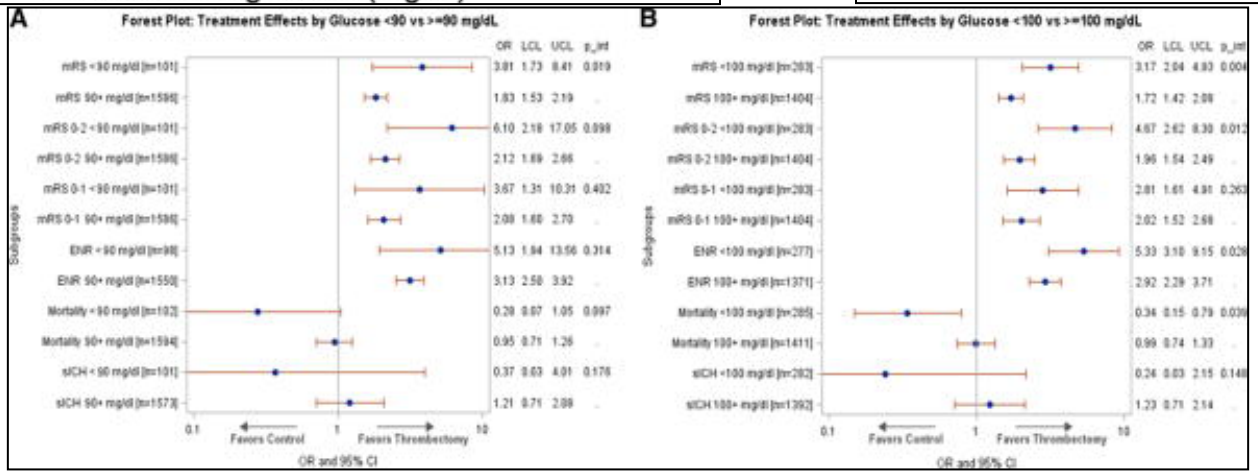
Blood glucose and succes of thrombectomy



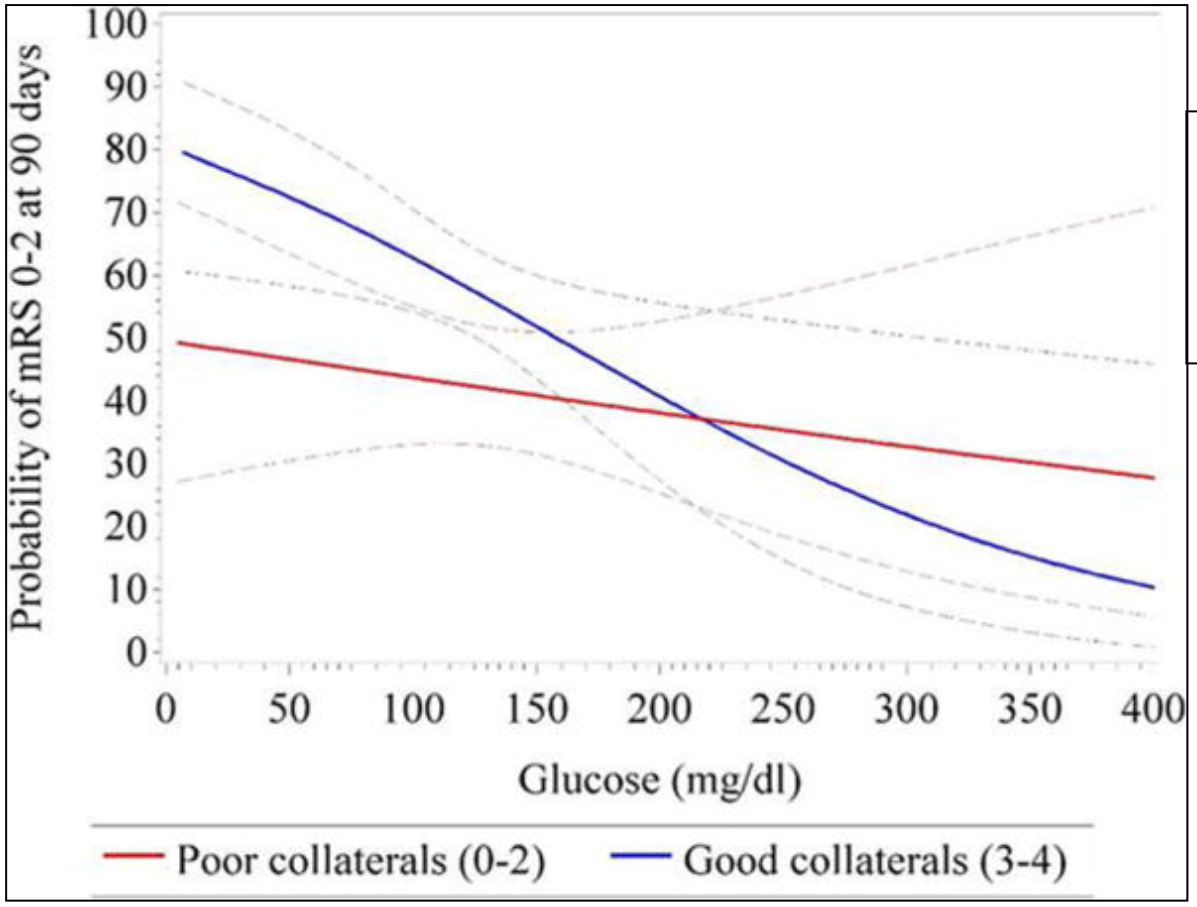
Glucose Modifies the Effect of Endovascular Thrombectomy in Patients With Acute Stroke: A Pooled-Data Meta-Analysis.

Chamorro, Angel; Brown, Scott; Amaro, Sergio; Hill, Michael; Muir, Keith; Dippel, Diederik; van Zwam, Wim; Butcher, Ken; Ford, Gary; den Hertog, Heleen; Mitchell, Peter; Demchuk, Andrew; Majoie, Charles; Bracard, Serge; Sibon, Igor; Jadhav, Ashutosh; Lara-Rodriguez, Blanca; van der Lugt, Aad; Osei, Elizabeth; Renu, Arturo; Richard, Sebastien; Rodriguez-Luna, David; Donnan, Geoffrey; Dixit, Anand; Almekhlafi, Mohammed; Deltour, Sandrine; Epstein, Jonathan; Guillon, Benoit; Bakchine, Serge; Gomis, Meritxell; du Mesnil de Rochemont, Richard; Lopes, Demetrius; Reddy, Vivek; Rudel, Gernot; Roos, Yvo; Bonafe, Alain; Diener, Hans-Christoph; Berkhemer, Olvert; Cloud, Geoffrey; Davis, Stephen; van Oostenbrugge, Robert; Guillemin, Francis; Goyal, Mayank; Campbell, Bruce; Menon, Bijoy

Stroke. 50(3):690-696, March 2019.
DOI: 10.1161/STROKEAHA.118.023769



Blood glucose and succes of thrombectomy



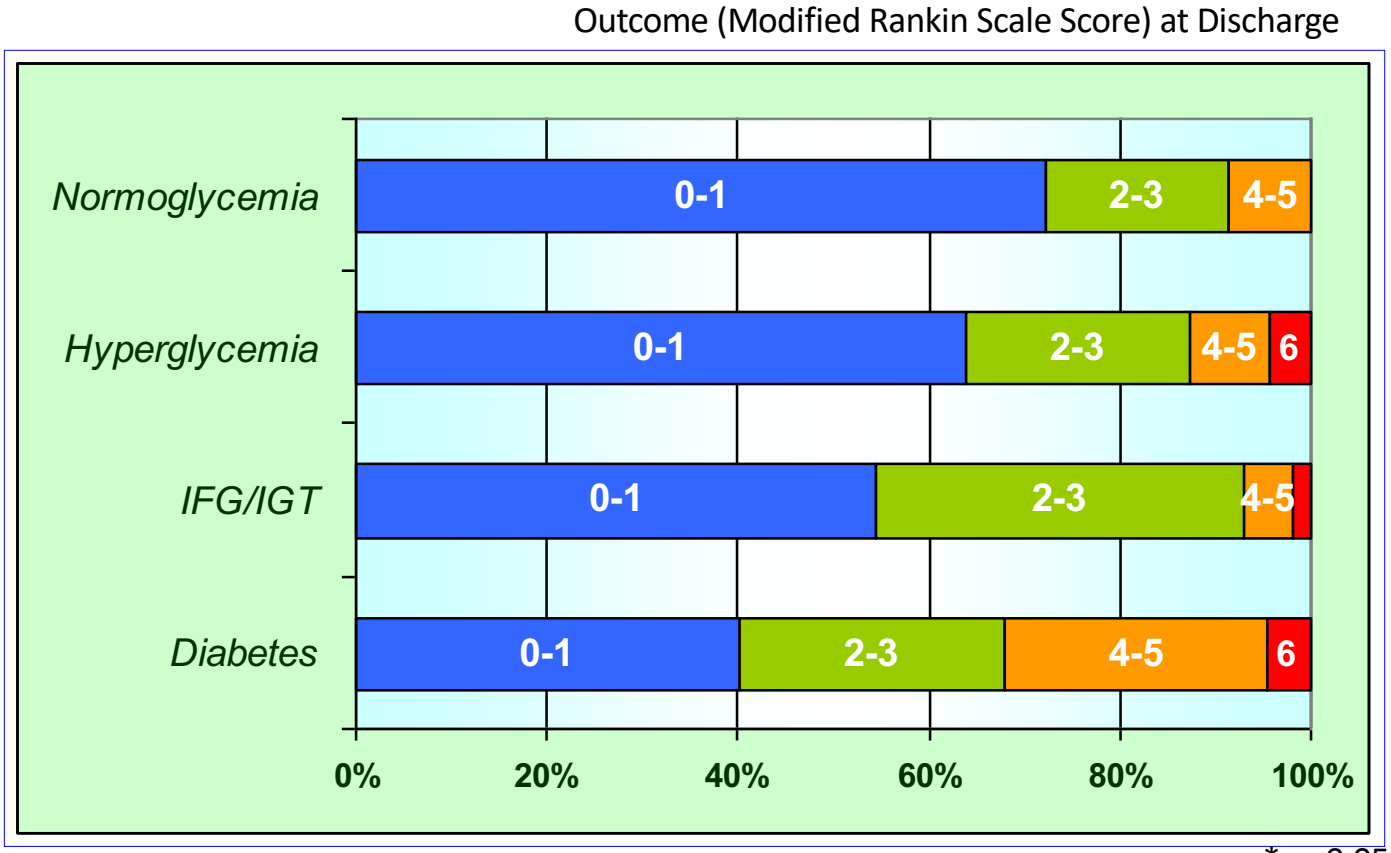
Impact of Hyperglycemia According to the Collateral Status on Outcomes in Mechanical Thrombectomy.
Kim, Joon-Tae; MD, PhD; Liebeskind, David; Jahan, Reza; Menon, Bijoy; Goyal, Mayank; Nogueira, Raul; Pereira, Vitor; Gralla, Jan; Saver, Jeffrey

Stroke. 49(11):2706-2714, November 2018.
DOI: 10.1161/STROKEAHA.118.022167

Figure 2 . Estimated probability of good outcome (modified Rankin Scale [mRS] score of 0-2) at 90 d as a function of the glucose levels at presentation in separate cohorts according to the collateral status (poor collaterals; 0-2 vs good collaterals; 3-4).

Triple S database of Solitaire stent TE trials

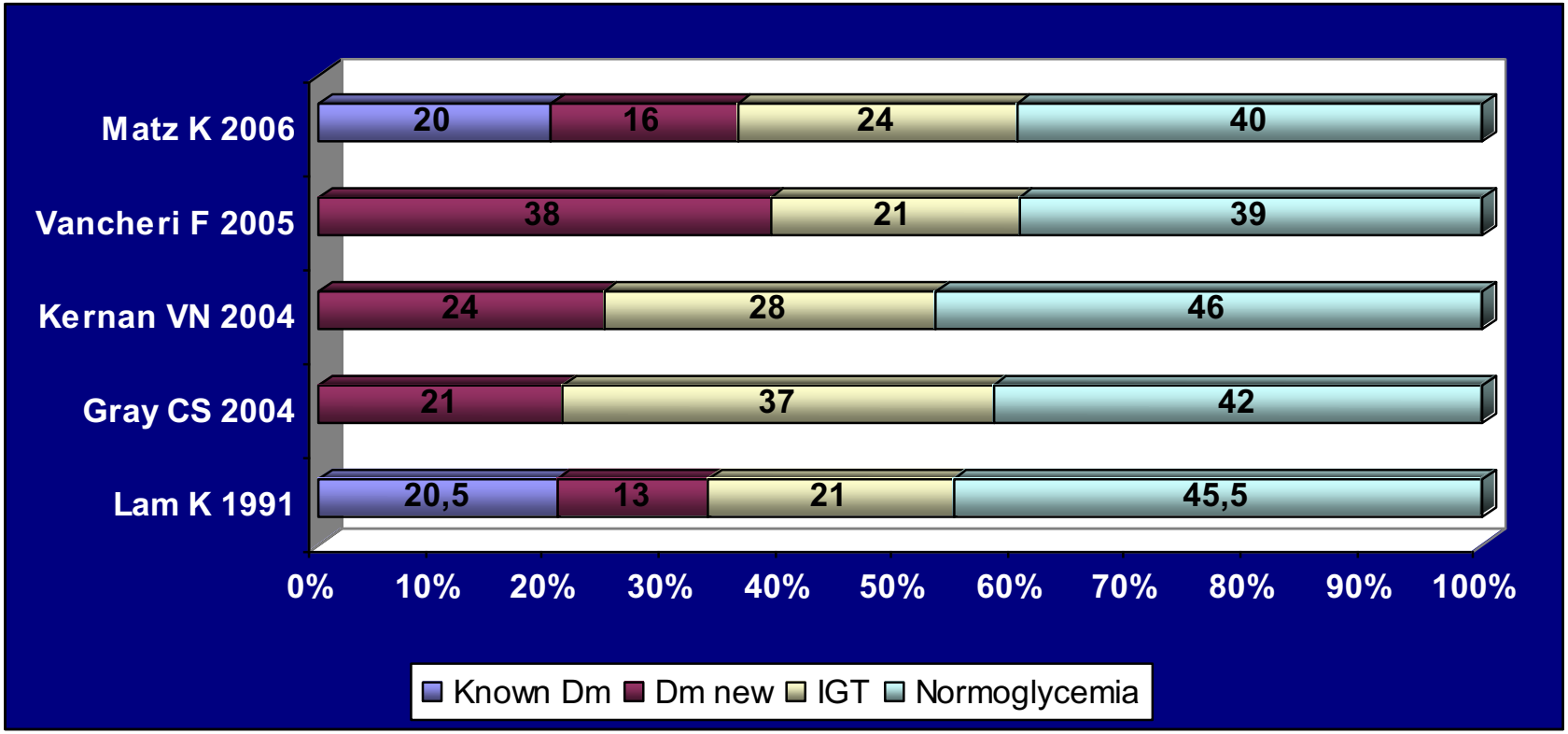
Patients with DM (previously kown and detected by OGTT) have a lower probability of favorable outcome



N=238

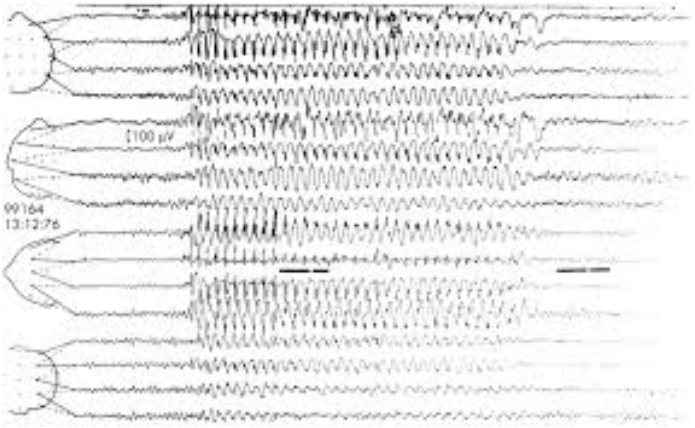
Matz K et al, Diabetes Care 2006; 29: 792-97

Prevalence of disorders of glucose metabolism in patients with acute stroke



Management of complications: Post stroke seizures (ischemic stroke)

- Early: within first two weeks
  - Prevalence among stroke patients 5-7%
    Ryvlin P, et al, Neurology. 2006
  - Onset-24h:
    40% - 66% of early seizures



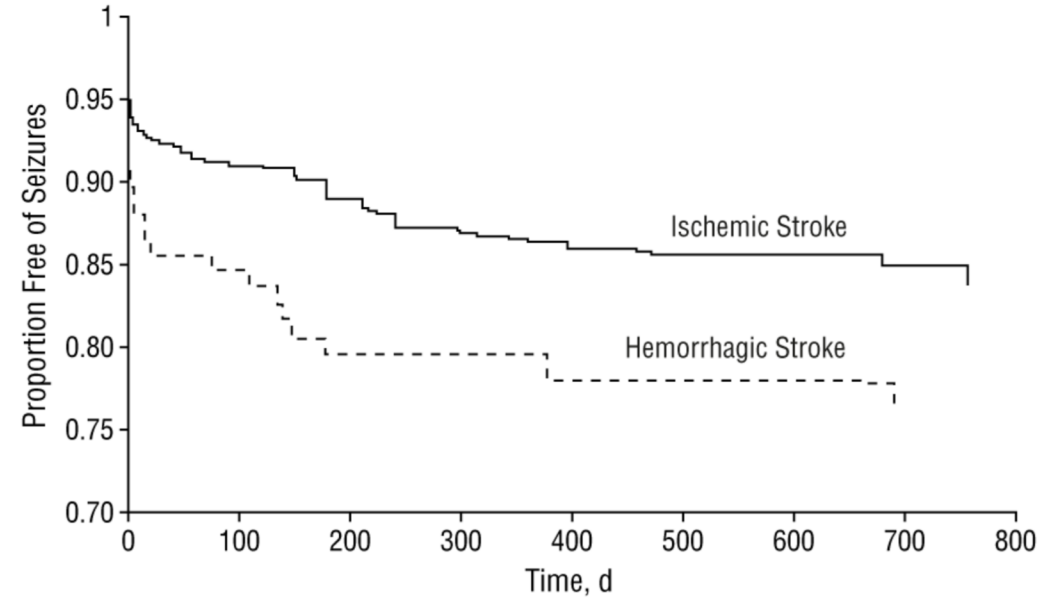
- Late: > two weeks
  - Prevalence 2-3 % after 1 year, 9% after 10 years , Sol et al ,Neurology 2016

Epidemiology

SASS Study

From: **Seizures After Stroke A Prospective Multicenter Study**

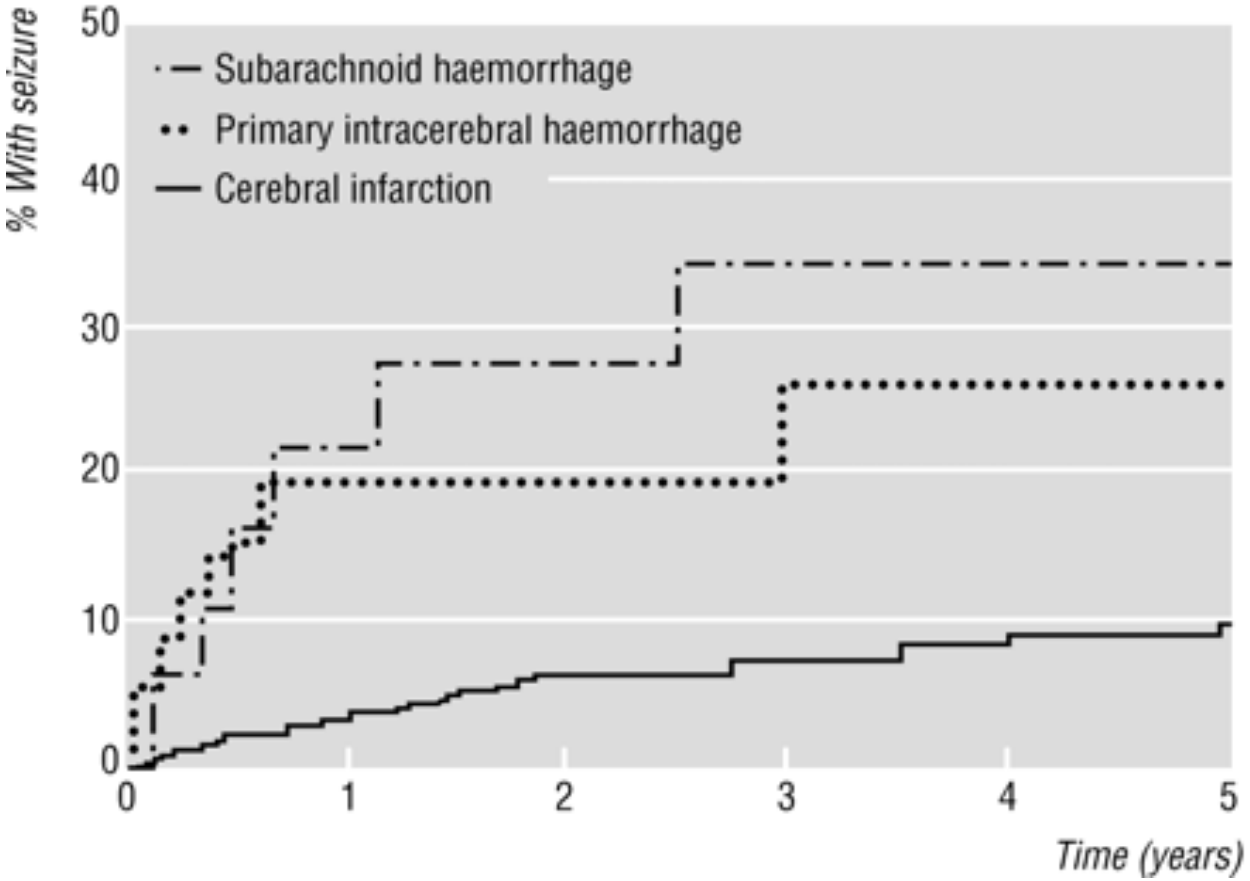
Arch Neurol. 2000;57(11):1617-1622. doi:10.1001/archneur.57.11.1617



Kaplan-Meier survival curves for patients with ischemic and hemorrhagic stroke showing the probability of remaining free of seizures after stroke. There was a significant difference (log-rank test) between the seizure event curves (P = .002).

Epidemiology

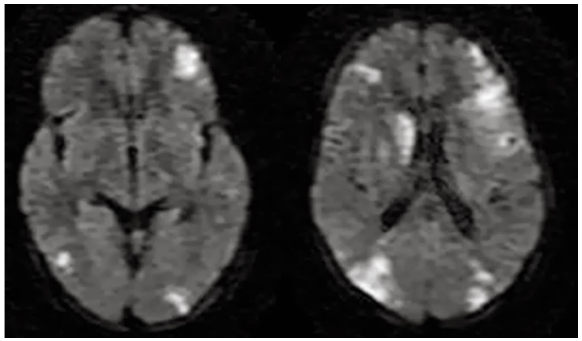
Oxfordshire community project



Burn J et al, BMJ 1997

Risk factors for post stroke seizures (ischemic stroke)

- Stroke type and localization:
  - Cortical involvement, esp. superior temporal, parietotemporal ,supramarginal cortex
  - Multiple sites
  - SVD: if combined with leukaraiosis



- Hemorrhagic transformation of infarct
- Reperfusion/Hyperperfusion syndrome
- Genes: rs671 for mt aldehyde dehydrogenase, CD40 1C/T

Seizure recurrence

- Recurrent seizures

  3% of stroke patients Bladin et al , JAMA Neurol 2001

  After 1st seizure:

  - FU 2 years: 36 % in prospective studies, 47 % in retrospective studies.
  - Overall in longterm follow up: 24 % to 65 %
  - Risk 35% after early 1st seizure , -90% after late 1st seiuzure

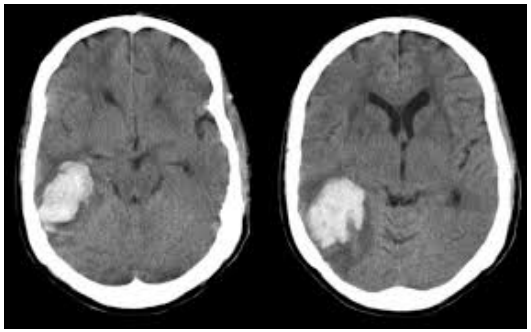
Risk factors for seizure recurrence

- Large lesions
- Cortical involvement
- Embolic stroke
- Younger age
- Male sex

Kim et al, BMC Neurol 2016

ICH

- Frequency of seizures : 10 -30%



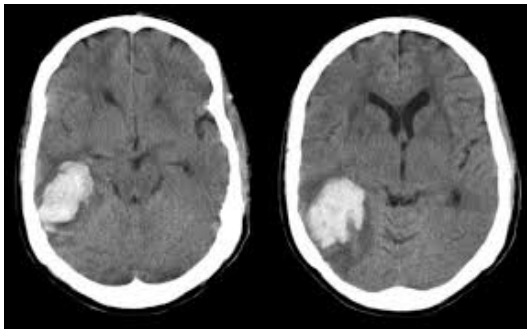
- High:
  - lobar hematoma with cortical involvement , esp. frontal, temporal , parietal lobes
  - Secondary ICH (neoplasm, AVMs)
- Low: basal ganglia ICH , intraventricular ICH

Weisberg LA, et al, Neurology 1991;41:1197–1199.

Giroud M, et al, Epilepsia 1994;35:959–964.

- Pathogenesis: Iron ? , Thrombin ?

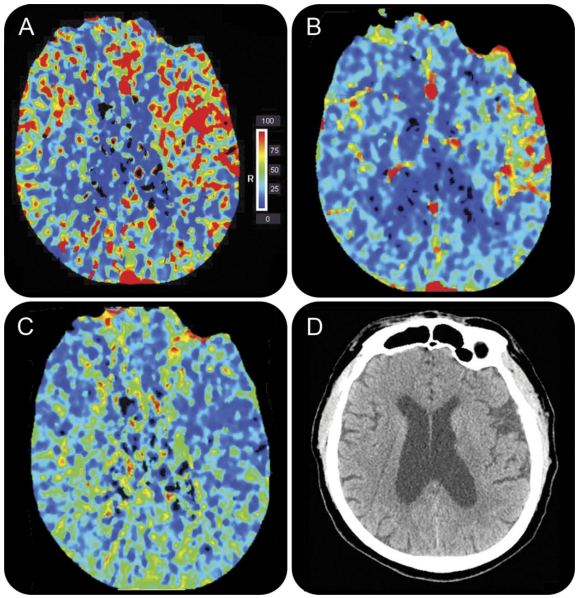
ICH



- Higher risk: age , alcohol abuse
- 50-60% are early seizures
- Late seizures : high recurrence rate

Hyperperfusion syndrome

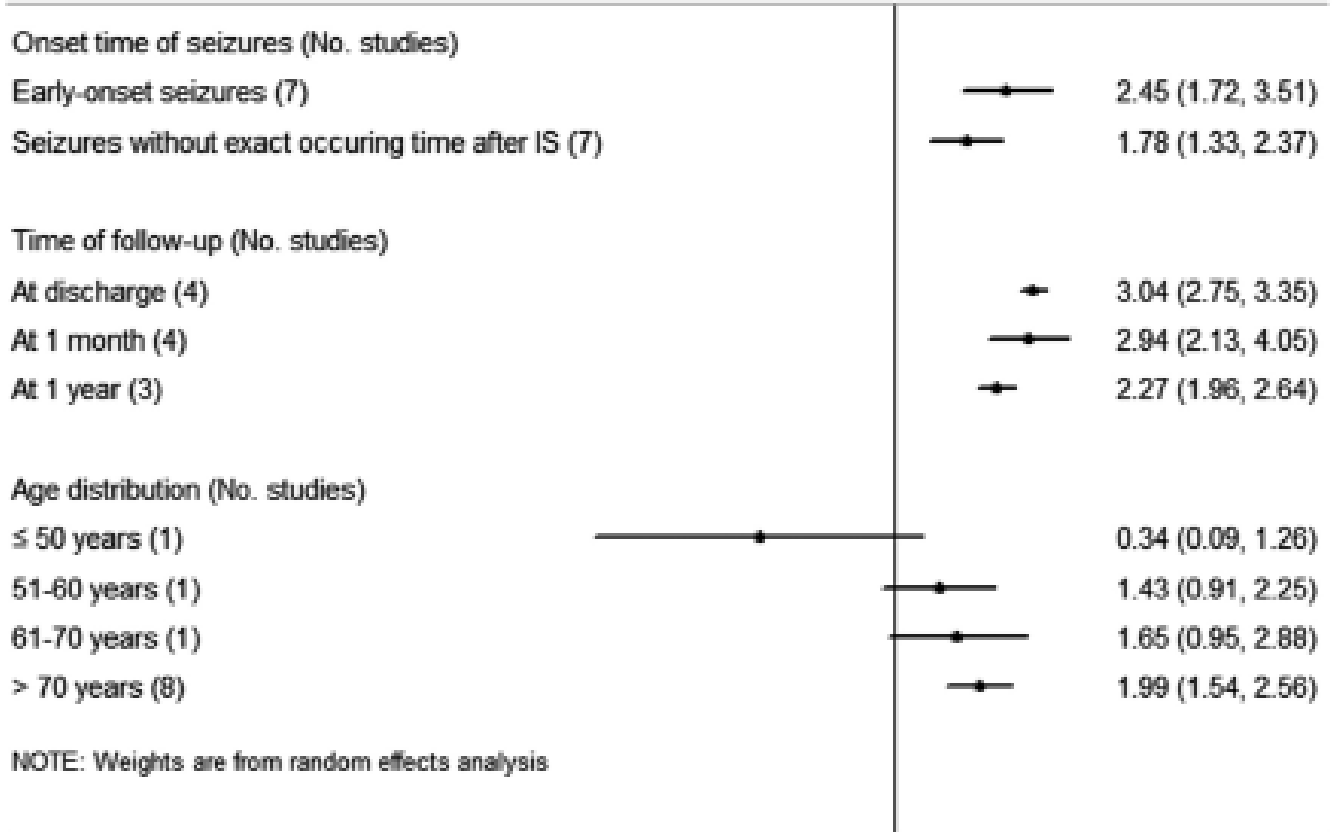
- After CEA , Carotid Stenting
- After Thrombectomy , esp. ICA , Carotid T
- Seizures in up to 90%
- PLEDS are common in EEG



Increased relative cerebral blood flow (A), increased relative cerebral blood volume (B), and decreased mean transit time (C)

Vivek B. Kalra et al. Neurology 2013;81:e25-e26

Impact on outcome - mortality



Tao Xu, et al , Medicine 2016

Treatment – general considerations for ischemic stroke

- No primary preventive treatment (i.e. stroke and no seizures) – exceptions ?

- Early PSS
  - unprovoqued: treat with AED , duration 2 weeks to 3 months
  - provoqued: observe , with EEGs

- Post stroke epilepsy:
  - Single late unprovoqued seizure : treat with AED, duration 1 – 2 years

  - Late recurrent seizure: treat with AED, duration indefinite

Secondary prophylaxis

- **A** Antithrombotics, Anticoagulation
- **B** Blood pressure , <140/90
- **C** Cholesterol (LDL <70 mg/dl), Carotid Surgery
- **D** Diabetes management, prediabetes Screening
- **E** Exercise + other life style measurements (inkl. quit smoking !)