

# Stroke Guidelines

## of the Bern Stroke Network

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### Physicians on duty

Neurology  
Neuroradiology  
Neurosurgery  
Radiology  
Anesthesia  
Intensive Care Unit  
Cardiology  
Internal Medicine  
Infectiology

### Phone numbers

### Miscellaneous

Resuscitation (CPR)  
Laboratory results  
Bed scheduling  
Stroke Unit

### Phone numbers

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Stroke Guide



StrokeClock



Stroke Amb

## Apps by Stroke Center Bern

Links to additional documents including pediatric stroke guidelines

[www.strokecenter.ch](http://www.strokecenter.ch)

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Drawings from Anja Giger, may be freely distributed with appropriate source citation.

Eye chart: PD M. Abegg, S. Küng; Translation corrections: S. Kaplan

# Ambulance Guide

<b>Case history</b>	<b>Diagnostics</b>
<ul style="list-style-type: none"> <li>• Symptom onset or last-seen-well time</li> <li>• Previous history/medication?</li> <li>• Relevant pre-existing condition?</li> <li>• Pacemaker/artificial heart valve?</li> <li>• Phone number of GP/next of kin</li> </ul>	<ul style="list-style-type: none"> <li>• ABC scheme</li> <li>• Glucose</li> <li>• Temperature</li> <li>• GCS</li> <li>• RACE or G-FAST score</li> </ul>
<b>Triage</b>	
See chapter on patient triage Early information transmitted to Stroke Centre/Unit to decide triage, fastest transportation	
<b>Position</b>	
⇒ Supine position – max. 30° if possible (when indicated due to other reasons higher positions are possible, e.g. if patient has respiratory problems)	
<b>Therapy</b>	
⇒ Venous line ⇒ Aim blood oxygen saturation > 92% ⇒ BP aim   120–220 mmHg syst, < 120 mmHg diast > 220 mmHg syst. or > 120 mmHg diast: lower carefully < 120 mmHg syst: 500 ml NaCl <b>WARNING</b> Do not administer aspirin, heparin or similar medication	

## Patient triage

<b>Symptom onset &lt; 4.5 h</b>	<b>RACE score &lt; 5</b> → admit to nearest Stroke Unit (if IVT can be initiated within 4.5 h) eventually IVT and transport to stroke center in case of large vessel occlusion: ICA, Carotid T, M1, M2, BA, P1, A1  <b>RACE Score ≥ 5</b> Distance to Stroke Center < 20 min longer than to Stroke Unit → admit directly to Stroke Center Distance to Stroke Center > 20 min longer than to Stroke Unit → admit to Stroke Unit and eventually IVT and transport to Stroke Center in case of large vessel occlusion: ICA, Carotid T, M1, M2, BA, P1, A1
<b>Symptom onset 4.5–24 h</b>	→ admit to nearest Stroke Center
- Unclear symptom onset - Wake-up stroke - Patient under (D)OAC - Contraindication for IVT	→ admit to nearest Stroke Center
<b>Symptom onset &gt; 24 h</b>	→ admit to nearest Stroke Unit or Stroke Center

Stroke Unit: availability of IVT, Stroke Center: availability of IVT + EVT

IVT: intravenous thrombolysis, EVT: endovascular treatment

ICA: internal carotid artery, BA: basilar artery, M1-2: middle cerebral artery, A1: anterior cerebral artery,

P1: posterior cerebral artery

## RACE Score



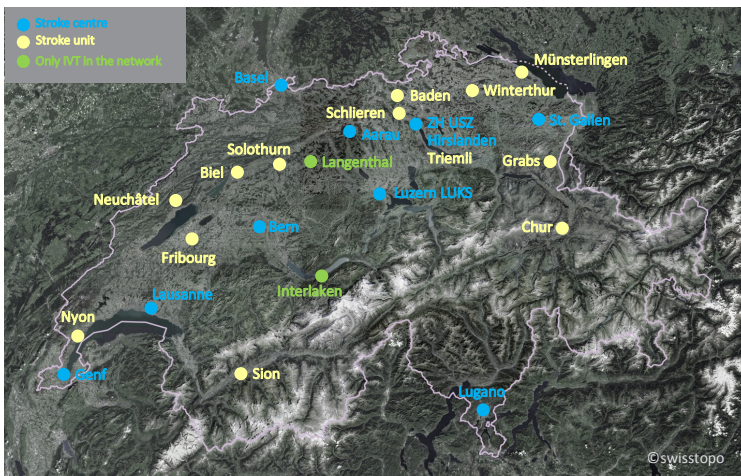
Stroke Amb

	<b>"Show me your teeth"</b>	
	No palsy (symmetrical movement)	0
	Mild (slight asymmetric)	1
	Moderate to severe (complete asymmetry)	2
	<b>"Extend your arms and hold them there" (supine 45°, otherwise 90°)</b>	
	Normal to mild: arms held out > 10 sec	0
	Moderate: one or both arms held out < 10 sec	1
	Severe: unable to raise arm(s) against gravity	2
	<b>"Extend your legs and hold them there" (30° in supine position)</b>	
	Normal to mild: legs raised for > 5 sec	0
	Moderate: one or both legs raised for < 5 sec	1
	Severe: unable to raise leg(s) against gravity	2
	<b>Gaze deviation</b>	
	Absent	0
	Deviation of eyes or head	1
If palsy is right-sided 	<b>"Close your eyes" + "Make a fist"</b>	
	Normal, both commands followed	0
	Moderate: one command not followed	1
	Severe: neither of the commands followed	2
If palsy is left-sided 	<b>"Whose arm is this?" + "Does your arm feel weak?"</b>	
	Normal: recognizes arm, aware of impairment	0
	Asomatognosia or anosognosia	1
	Asomatognosia AND anosognosia	2

### Probability of large vessel occlusion depending on summed score

1	8%	4	34%	7	72%
2	14%	5	47%	8	81
3	22%	6	61%	9	86%

# Swiss Stroke centres and units



be SAFE

## STROKE PATH

FAST

Registration	? Symptoms, Symptom Onset ? ABCDE ? Arrival time
ED/trauma room	Inform ED or trauma room
Prenotification	CT/MRI, Anaesthesia
Drip & ship?	Notify team in case of drip and ship, angio suite free?

ED arrival	<b>Start Stroke Clock App</b> <b>Blood tests, 2nd venous line</b> <b>Monitoring?</b> criteria-----→ <b>NIHSS</b> (do not waste time) <b>ECG?</b> only if chest pain or other clear indication	<b>Monitoring until CT/MRI if</b> Unstable during transport to ED $O_2 > 2l/min$ $BP \text{ sys} > 200 \text{ or} < 100$ $HR > 110 \text{ or} < 50$ Relevant disturbance of consciousness
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Acute care nurse	<b>Acute care nurse accompanies every patient</b>	<b>If not available:</b> Anaesthesia if monitoring is indicated
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CT or MRI	<b>MRI, except in</b> <ul style="list-style-type: none"> <li>• Pacemaker</li> <li>• Implants not MR compatible</li> <li>• Disturbance of consciousness</li> </ul>	<ul style="list-style-type: none"> <li>• History of implants not clear (e.g. aphasia, severe dementia)</li> <li>• Vomiting</li> </ul> + pregnancy t?? (→MR with contrast agent)
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MRI priority?	<b>Priority 1</b> ASAP IVT/EVT indication Symptom onset <12h	<b>Priority 2</b> within 20 min Presumably no IVT/EVT indication Symptom onset 12– 24h	<b>Priority 3</b> within 3h TIA > 2h otherwise S2 Symptom onset > 24h
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Arrival CT/MR	MR questionnaire
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Monitoring MR	<b>Monitoring during MR</b> $O_2$ needed for Biox >92% $BP \text{ sys} > 165 \text{ or} < 100$ $HF > 110 \text{ or} < 50$ Pat. cannot ask for help by him/herself	<b>Acute care nurse in MR if</b> Patient cannot ask for help by him/herself Patient agitated
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Physician presence	<b>Obligatory in case of</b> Priority 1+2: always Priority 3: if criteria for monitoring in MR are fulfilled (exception $O_2 < 4l$ )	<b>Not required if</b> DWI/SWI/TOF negative + no other indication for surveillance by physician
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Therapy decision	<b>IVT</b> only if $BP < 185/105$ , CAVE fever endocarditis!), see chapter on contraindications for IVT <b>EVT</b> decision on intubation together with interventionist
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IVT/EVT	<b>IVT</b> start in MR/CT <b>EVT</b> Transfer of patient to interventionalist + anaesthesia in NeuroAngio
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Stroke Unit /ICU	Request a bed SU/ICU
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Arrival SU/ICU	ECG
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max 10'

max 15'

# Indications and choice of therapy

Symptoms		Vessel occlusion				Time & imaging results	
NIHSS score $\geq 4$		< 4.5		4.5–9 h		Wake up/ Unknown onset/ 9h - at least 24h:	
or		Treatment irrespective of core-perfusion mismatch		Usually independently of core-clinical mismatch or core-perfusion mismatch		in case of core-clinical mismatch or core-perfusion mismatch	
NIHSS < 4 with relevant deficits (e.g. aphasia, hemianopsia, distal paresis, etc.)		ICA, Carotis-T, M1, M2 P1, A1, VA		Bridging IVT + EVT IVT + consider EVT		EVT if mismatch* <sup>§</sup> EVT if mismatch* <sup>§</sup>	
or		M3/4, P2, A2		IVT, consider Urokinase i.a.		IVT if mismatch <sup>#</sup> IVT if mismatch <sup>#</sup>	
consider in case of minor deficits and/or rapidly improving symptoms with persistent vessel occlusion		BA		Bridging IVT + EVT		consider EVT <sup>§</sup> IVT if mismatch <sup>#</sup>	
		No vessel occlusion		IVT			
		Ophthalmic artery/centralis retinae artery		IVT			
		spinal ischemia		IVT		IVT bis 6h erwägen	



\* **Core-clinical mismatch** (NIHSS  $\geq 10$  and core < 1/3 of the MCA territory (consider EVT in younger patients despite large core) or **core-perfusion-mismatch**)

# **DWI-FLAIR mismatch** (without or only minor FLAIR demarcation of the DWI lesion) or **core-perfusion mismatch** (core < 70mL, mismatch Ratio > 1.2)

§ if EVT cannot be performed due to technical/anatomical reasons: consider IVT also in case of large vessel occlusion > 4.5h after symptom onset in case of mismatch (see #)

IVT: intravenous thrombolysis, EVT: endovascular treatment, BA: basilar a., M1-4: middle cerebral a., A1-2: anterior cerebral a., VA: vertebral a., P1-2: posterior cerebral a.

IVT	EVT	
Absolute	Relative	Septic embolization, endocarditis, encephalitis, pancreatitis
		Intracranial haemorrhage
		INR > 1.7
		Surgery at non-compressible sites within the past 10 days
		Severe trauma
		Intraparenchymal haemorrhage within the past 3 months
		Delivery within the past 14 days
Relative	Relative	Gastrointestinal haemorrhage within the past 21 days
		Blood pressure above 185 mmHg sys./105 mmHg dias. after BP treatment
		Coagulopathy, incl. tumour-associated (e.g. in patients with leukaemia) and prolonged aPTT
		Thrombocytopenia < 100,000
		Pregnancy (IVT may be considered as off-label treatment)
		Ischaemic stroke within the past 2 months
		Septicaemia
Relative	Relative	Hypoglycaemia < 2.7 mmol/l or hyperglycaemia > 22.2 mmol/l
		Sodium < 120 mmol/l or > 150 mmol/l
		Severe underlying disease, short life-expectancy

## Notes

- **IVT in patients previously treated with antiplatelet aggregation therapy**
  - Monotherapy: aspirin/clopidogrel/aspirin+dipyridamole/ticagrelor: no restrictions
  - Dual therapy: aspirin+clopidogrel: no restrictions; other combinations: consider IVT carefully
  - Monotherapy or combination therapy with prasugrel: consider IVT carefully
  - Triple therapies: no IVT
- **Bridging (IVT + EVT)**
  - normally full dose alteplase 0.9 mg/kg KG
  - normally no control imaging before EVT except in the case of clinical deterioration
- **Large infarction DWI/CBV (> 100 mL):** consider EVT in younger patients (< 75 years, and especially if < 60 years)

# IVT dosage

Weight		Alteplase (Actilyse®)			Weight	Tenecteplase (Metalyse®)
(kg)	Sum dose 0.9 mg/kg	Bolus 10% in 1 min	Perfusor 90% over 60 min	(kg)	Apply as bolus within 5–10 sec	
44–47	40 mg = 40 ml	4 ml	36 ml/h	<60	6,000 U = 6 ml	
48–51	44 mg = 44 ml	4 ml	40 ml/h	60–69.9	7,000 U = 7 ml	
52–54	47 mg = 47 ml	5 ml	42 ml/h	70–79.9	8,000 U = 8 ml	
55–57	50 mg = 50 ml	5 ml	45 ml/h	80–89.9	9,000 U = 9 ml	
58–62	54 mg = 54 ml	5 ml	49 ml/h	≥90	10,000 U = 10 ml	
63–67	59 mg = 59 ml	6 ml	53 ml/h			
68–72	63 mg = 63 ml	6 ml	57 ml/h			
73–77	68 mg = 68 ml	7 ml	61 ml/h			
78–82	70 mg = 70 ml	7 ml	63 ml/h			
83–88	77 mg = 77 ml	8 ml	69 ml/h			
89–92	80 mg = 80 ml	8 ml	72 ml/h			
93–97	86 mg = 86 ml	9 ml	77 ml/h			
≥98	90 mg = 90 ml	9 ml	81 ml/h			

Note: when administering 2/3 of the dose, stop the perfusor after 40 min.

# IVT in patients treated with DOAC

	Dabigatran (Pradaxa®)	Rivaroxaban (Xarelto®)	Apixaban (Eliquis®)	Edoxaban (Lixiana®)
<b>Emergency measurement of:</b>	- anti-IIa activity - thrombin time - aPTT	- Anti-Xa activity for rivaroxaban - INR - aPTT	- Anti-Xa activity for apixaban - INR - aPTT	- Anti-Xa activity for edoxaban - INR - aPTT
<b>IVT without restrictions possible when last dose was taken more than 48h ago, or if:</b>	Thrombin time normal  or anti-IIa activity not detectable	Anti-Xa activity not detectable	Anti-Xa activity not detectable	Anti-Xa activity not detectable
<b>Consider IVT in individual situations with possible higher bleeding risk if:</b>  (these recommendations require, in addition, normal coagulation)	Anti-IIa activity for dabigatran < 100 ng/ml*  If anti-IIa >100 ng/ml a./o. aPTT prolonged: consider antagonizing with idarucizumab (s.p. 12) and then start IVT	Anti-Xa activity for rivaroxaban < 100 ng/ml*	Anti-Xa activity for apixaban < 100 ng/ml*	Anti-Xa activity for edoxaban < 100 ng/ml*

Note: \*Consider timepoint of measurement (potential further increase of activity if peak activity is not reached)

# Monitoring during IVT + EVT

## IVT

- 1. Measure BP every 5 minutes:** target sys.  $\leq 185$  mmHg, diast.  $\leq 105$  mmHg
  - in the case of  $> 185/105$ : re-check after 5 minutes
  - if BP persists  $> 185/105$ : BP lowering (see Antihypertensive medications, below)
- 2. Respiration:** control of oxygen saturation: target Biox  $> 92\%$
- 3. Evaluation of pupils:** 3  $\times$  per hour
  - **in case of clinical deterioration:** stop alteplase; CT: haemorrhage?
  - **in case of allergic reaction:** stop alteplase, administer clemastine 2 mg, methylprednisolone 250 mg i.v. for extreme anaphylaxis: adrenalin 0.3–0.5 mg s.c.; for very extreme anaphylaxis: adrenalin 0.05–0.1 mg i.v.
  - **in case of plasma glucose  $> 11$  mmol/l:** reduce carefully with insulin

## EVT

- during EVT BP MAP aim for 70–90 mmHg; after successful reperfusion (TICI 2b&3):  $< 140/95$  mmHg

## Antihypertensive medication (iv)

Use (standard values)	Medication	Dosage	Maximum effect	Warnings/Side effects
bolus administration	<b>Urapidil</b> 50 mg/vial	2.5–10 mg (1 ml = 5 mg) max 50 mg/d	10 min	Vertigo, headache, dyspnoea, arrhythmia (tachycardia or bradycardia)
bolus administration for HR $> 70$ /min	<b>Labetolol</b> 100 mg/vial	5–10 mg (1 ml = 5 mg) max 200 mg/d	15 min	Bradycardia, AV-block, hypotension, vertigo, nausea, paresthesia, bronchial spasm
bolus administration for HR $> 70$ /min	<b>Metoprolol</b> 5 mg/vial	1–2.5 mg (1 ml = 1 mg) max 15 mg/d	5 min	Bradycardia, AV-block, low output syndrome, bronchial spasm
bolus administration for HR $< 70$ /min	<b>Dihydralazin</b> 25 mg/vial	6.25 mg slowly over 2 minutes (1 ml = 12.5 mg) max 100 mg/d	20 min	Oedema, tachycardia, angina pectoris; exercise caution in the case of liver or renal failure  CI: Coronary insufficiency
Perfusion therapy	<b>Urapidil</b> 50 mg/vial	5–10 mg/h max. 40 mg/h	–	Restricted to 48 h therapy
Perfusion therapy	<b>Labetolol</b>	10–40 mg/h max 100 mg/h (1 ml = 1 mg)	–	Bradycardia, AV-block, hypotension, vertigo, nausea, paresthesia, bronchial spasm

## Vasopressor therapy (iv)

Use (standard values)	Medication	Dosage	Start	Warnings/Side effects
Perfusion therapy	<b>Noradrenalin</b> <sup>•</sup> 10 mg/vial	Maximal dosage 0.1 $\mu\text{g}/\text{kg}$ BW /min  Higher dosage only on ICU	Start with 0.01 $\mu\text{g}/\text{kg}$ BW/min  then titrate	CI: Hyperthyreosis, tachycardia arrhythmias, angle-closure glaucoma, pheochromocytoma, cardiomyopathy (esp. hypertrophic)  Compensate hypovolaemia first

# Stroke Unit treatment

## First neurological examination immediately after arrival

### Cardiovascular monitoring:

- BP upper limits during the early phase:
  - ≤ 185/105 mmHg after IVT
  - ≤ 140/95 mmHg after successful EVT (TICI 2b or 3), otherwise ≤ 185/105 mmHg
  - ≤ 220/110 mmHg in conservatively treated patients
- BP lower limit: only in selected cases in case of hypoperfusion/symptom worsening with drop of BP => to increase BP: only temporary administration of a limited volume of infusion solution (max. 500 ml); in other cases use vasopressors (e.g. Noradrenaline)
- Tachycardia > 100 bpm => usually beta blockers; in case of tachycardic atrial fibrillation consider adding digoxin
- Frequent ventricular extrasystole => magnesium 2 g i.v.
- Bursts of ventricular extrasystole (more than 3 beats): usually beta blocker + magnesium; ≥10 beats or polymorph or >120/min or clinically symptomatic => consultation with cardiologist
- Bradycardia: during sleep in asymptomatic patients, usually up to 35 bpm is tolerable
- Pause > 3 seconds => consultation with cardiologist

### Respiration: target Biox ≥ 92; screening for sleep apnoea

- If > 4l O<sub>2</sub>/min is necessary or respiration frequency > 20 => clinical examination, arterial blood gas analysis, chest X-ray (pulmonary embolism? cardiac failure? pneumonia?)
- If respiration frequency > 25–30 there may be a danger of respiratory exhaustion

### Body temperature: ≥ 38° -> antipyretics (1st choice paracetamol) + 2x2 blood cultures, empirical/causal treatment

### Neurological evaluation: usually every 2h during the first 24h

### Clinical general medical evaluations: cardiac compensation, lungs, abdomen to be checked daily

### Prescription of medication:

- Do not prescribe antiplatelet aggregation therapy after IVT/i.a Urokinase before exclusion of haemorrhage in control CT/MRI after 24h
- General cardiac premedication should be continued, with potential reduction of dose (WARNING cardiac failure/rebound tachycardia after stop)
- Stop any antihypertensive medication in the case of haemodynamic stroke

### Laboratory controls: (24h after IVT/EVT)

- Hb, Lc, Tc, CRP, glucose, Na, K, creatinine, INR
- hs-Troponin T and ECG after 1 h if initially abnormal
- Anaemia: transfusion if Hb < 90 g/l
- Tc daily under heparin therapy; further laboratory examinations individually determined

### Neuroradiological control:

- 24h after IVT/EVT, MRI (or CT), including MRA (CTA) except in patients with severe renal insufficiency
- In case of neurological deterioration immediately

### Swallowing: in case of dysphagia, reduced consciousness, facial palsy or relevant neuropsychological deficits: swallowing test (GUSS: Gugging Swallowing Screen)

### Nutrition and fluid balance:

- Daily fluid intake requirement: 30–35 ml/kg body weight
- Daily energy demand: 35 kcal x body weight
- If sufficient oral energy supply cannot be given within 3 days after stroke: enteral feeding via nasogastric tube with high caloric fibrous enteral feeding as bolus application 3–4x/d; control of electrolytes (incl. magnesium and phosphate)
- If fasting period > 7 days: delayed feeding (WARNING refeeding syndrome)

# Mobilization

Day 0	Day 1 and thereafter
Subacute stroke > 2d	
TIA without vessel occlusion	
Small infarcts, without symptoms, without vessel occlusion, conservative treatment	
Infarct, NIHSS $\geq 1$ , without vessel occlusion, conservative treatment	
Stroke pontine/internal capsule	
Vessel occlusion/haemodynamic watershed infarcts/symptoms, conservative treatment	No penumbra, not pontine/internal capsule stroke
	Persistent penumbra, severe hypoperfusion, haemodynamic watershed infarcts/symptoms
IVT/EVT/Bridging	Reperfusion, not pontine/internal capsule stroke
	Persistent penumbra
<p>Mobilization without restriction</p> <p>Mobilization delayed (possibly slower in case of persistent penumbra or mobilization-dependent symptoms)</p> <p>30° (*supine position if possible)</p>	<p><b>Mobilization delayed</b></p> <p>Level 1: 30°</p> <p>Level 2: sitting</p> <p>Level 3: walking with assistance, if patient is steady then free mobilization is possible</p>

## Daily checklist – visiting stroke patients

1	<b>Neurological evaluation</b>	NIHSS and symptom-orientated functional examination (results of physio-, ergo-therapy, speech therapy); depression? sleep-wake disorder?
2	<b>Clinical evaluation</b>	Cardiac compensation, lung, abdomen, fever?
3	<b>Monitoring</b>	Relevant rhythmic disorders (regarding reason, haemodynamic, cardiac pathology) BP target value? BP actual value?
4	<b>Mobilization?</b>	
5	<b>Nutrition, dysphagia?</b>	
6	<b>Laboratory controls?</b>	Especially electrolytes, inflammation parameters, kidney, haemostasis
7	<b>Medication</b>	Antithrombotic therapy? Deep vein thrombosis prophylaxis? BP therapy?

## Prevention of deep vein thrombosis

- In case of IVT, bridging, Urokinase initiation: after exclusion of cerebral haemorrhage in the follow-up-imaging
- After mechanical thrombectomy without IVT and with conservative therapy: start immediately
- Under heparin Tc control on day 1, then every 3 days (HIT?, 4Ts score)
- Pneumatic compression stockings may be an alternative if LMWH is contraindicated

# DD Neurological deterioration

? Reinfarction

? Infarct localization: e.g. secondary deterioration more frequent in internal capsula or pontine infarctions

? Haemodynamic: BP associated? Associated with mobilization?

? Bleeding

? Rising ICP

? Epileptic seizure

? **Infection**

? **Sedation**

? Psychogenic

and other less frequent causes

## Alteplase-associated ICH

In the case of symptomatic ICH or neurological deterioration within 24 after Alteplase administration:

→ Stop Alteplase

→ **Blood tests:** thrombocytes, INR, aPTT, fibrinogen, type and cross-match

→ **CT;** in case of bleeding:

→ **Fibrinogen (Haemocomplettan P)** or **Prothrombin complex concentrate** (involve haematology)

→ **Tranexamic acid** (Tranexam OrPha) i.v. 1000 mg, apply over 10min

→ BP aim  $\leq 140/90$  mmHg

## DD Myocardial inf. DD stress cardiomyopathy

hsTnT-elevation in approx. 20% of ischaemic stroke patients, DD: MI, stress cardiomyopathy (SCM), renal failure, hypertensive crisis, tachycardia, aortic dissection

Variable manifestation of SCM: hsTnT  $\uparrow$  < regional hypokinesia < transient apical ballooning

- The extent of hsTnT-elevation does not discriminate between MI and SCM

- SCM is an exclusion diagnosis

- In case of doubt consider cardiac MRI (best discrimination) or ergometry

**Possible practical approach in case of hsTnT-elevation:**

- Clinical correlate for MI (repolarization disturbance a./o. angina pectoris) → coronary angiography

- No clinical correlate: repeat ECG and hsTnT after 1 and 3 h, and, if necessary, after 6 h:

- hsTnT without relevant change (<20%): renal failure? heart failure? hypertensive state?

- hsTnT change >20%: consider cardiac MRI or coronary angiography

# Malignant infarcts

## General

- Usually 30° supine position
- BP aim: MAP > 85 mmHg, sys. < 220 mmHg
- **In case of imminent craniectomy: stop antiplatelet therapy**
- Pneumatic compression stockings for prevention of deep vein thrombosis
- Consider as emergency medication until craniectomy:
  - mannitol/hypertonic saline solution (dosage control of mannitol via osmotic gap, hypertonic saline solution via Na and osmolality)
  - Hyperventilation

## Decompressive craniectomy

- **Craniectomy if possible within 24–48 h** and before relevant neurological deterioration
- Critical phase with risk for neurological deterioration: 24–96 h (rarely up to as late as 10 d)
- Signs of rising ICP: decreasing consciousness, disturbance of pupillomotor function usually with dilatation in case of supratentorial swelling, and miosis in case of infratentorial swelling, increasing paresis, new ipsilateral paresis, pathological breathing pattern, rhythmic disorders
- **Possible practical approach:**
  - o general actions see above
  - o frequent clinical control and early CT control (e.g. 12 h after stroke) in case of infarct >2/3 middle cerebral artery territory or larger infratentorial stroke (e.g. complete PICA infarct or larger)
  - o aim: preventive decompression! Rescue therapy only in exceptional circumstances and probably associated with worse outcome

## Malignant infarctions of the middle cerebral artery territory

Predictors for malignant infarction: young patient, persistent vessel occlusion, early midline shift  $\geq 4$  mm, critical infarct volume dependent upon age/atrophy but  $\gg 80$  ml or  $> 1/2$  media territory, additional infarction in anterior or posterior territory

### Indications for craniectomy

1. Usually < 60 years, individually consider also in older patients
2. Symptom onset within the past 48 h (in exceptional cases this may be longer)
3. Infarction of at least half of the middle cerebral artery territory
4. Consent of patient or family
5. Indication independent from affected hemisphere (dominant vs. non-dominant)

### Contraindications

1. Bilateral fixed pupils and coma
2. More than 3 of the following unfavourable prognostic factors:
  - a. age > 50 years
  - b. infarction extends beyond the middle cerebral artery territory
  - c. unilateral dilated pupil
  - d. GCS < 8
3. Severe comorbidity; severe preexisting disability

## Malignant cerebellar infarctions

Predictors for malignant infarction: young patient, persistent vessel occlusion, bilateral infarction, the size has less predictive value because small infarcts may induce large oedema

### Indications for craniectomy

1. Larger infratentorial ischaemia (e.g. complete PICA stroke)
2. Imaging shows space-occupying infarction with progression in short term follow-up imaging
3. Consent of patient or family

### Contraindications

1. Clinical or imaging signs of severe irreversible brainstem damage
2. Severe comorbidity, severe preexisting disability

# Agitation/delirium

## General

- Screening: CAM (Confusion Assessment Method)
- Follow-up parameter: **RASS** (Richmond Agitation Sedation Scale):

+4 combative	+3 very agitated	+2 agitated	+1 restless	0 alert and calm
-5 unarousable	-4 deep sedation	-3 moderate sedation	-2 light sedation	-1 drowsy

## Diagnostic criteria ICD-10

1. **Reduced attention** → reduced perception of environment
2. **Disordered thinking**, manifest through
  - limited short-term memory
  - Disorientation (place, time, person)
3. **Psychomotor abnormalities**, of the following:
  - rapid, unpredictable change from hypo- to hyperactivity
  - extended reaction times
  - changed speaking speed
  - startle reaction
4. **Sleep abnormalities**, at least one of the following:
  - insomnia with or without daytime sleepiness
  - symptoms worse at night
  - nightmares (can sometimes continue into the day as hallucinations/illusional misjudgement)
5. **acute onset** and **fluctuating** throughout the day
6. Evidence of an organic brain or systemic disease (partly) responsible

## Treatment

1. **Eliminate/treat cause**
2. **Non-drug therapy measures**
  - circadian rhythmization
  - Stimulus reduction

## Symptomatic therapy

**In case of alcohol withdrawal delirium, 1st choice is benzodiazepines, otherwise use the following scheme:**

- Level 1:** Pipamperone 20 mg stepwise (maximal dose 360 mg/d)  
or Quetiapine 12.5 mg stepwise (maximal dose 800 mg/d)  
or/and Risperidone 2x0.5 mg/d (maximal dose 16 mg/d)  
or exceptional Haloperidol (Haldol®) 0.5–1 mg stepwise (maximal dose 60 mg/d)

**WARNING: arrhythmia → apply i.v. only exceptionally under monitoring**

- Level 2:** Diazepam 5 mg stepwise i.v. (increase up to 10 mg stepwise is possible)  
or Midazolam: 2.5–5 mg as bolus (maximal dose 10 mg)  
then, if necessary, 2–5 mg/h perfusion therapy (maximal dose 10 mg/h) – antidote: Flumazenil

**Level 3:** Clonidine: 25–50 µg as bolus, then 25–150 µg/h perfusion therapy (maximal dose 150 µg/h)

**Level 4:** Dexmedetomidine or Propofol with perfusor in ICU

**Special case, delirium in patients with stroke and Parkinson's disease**

→ Quetiapine (Seroquel®) 25–100 mg p.o., max. 300 mg/d

→ Clozapine (Leponex®) 6.25–12.5 mg, max. 100 mg/d; 2/3 of the dose at night, 1/3 throughout the day

**Special case, delirium in patients with stroke and alcohol withdrawal**

→ Primarily benzodiazepines + thiamine substitution

**Perform MRI in clinical TIA patients whenever possible**

**Pathological definition of TIA:** transient neurological deficit without diffusion restriction in MRI

**Time-dependent definition of TIA:** transient neurological deficits of < 24 h duration

**Definition of minor stroke:** NIHSS  $\leq 4$ , symptoms stable or improving

## DD TIA, seizure, migraine aura

**TIA:** usually negative symptoms, spread of symptoms usually fast

**Seizure:** usually positive symptoms, spread of symptoms fast

**Migraine aura:** usually positive symptoms, spread of symptoms over minutes

**TIA confirmation by neurologist**



**Persistent neurological symptoms  
or ABCD2 score > 4**



**MRI including MRA**

- Perfusion deficit?
- Symptomatic vessel stenosis/occlusion?



**Dependent?  
Monitoring needed?  
Important accompanying illness?**



**Cardiac examination**

- ECG: ACS? Relevant rhythmic disorder?
- TEE: cardiac emboli source with high risk?



**Laboratory:** relevant pathologies?



**Inpatient treatment**

**Outpatient  
treatment**

### ABCD2 Score (Stroke Risk after TOA)

Risk factor	Points
Age $\geq 60$ years	1
Systolic BP $\geq 140$ or diastolic $\geq 90$	1
Unilateral weakness with or without speech disturbance Speech disturbance without weakness	2 1
TIA duration $\geq 60$ min TIA duration 10–59 min	2 1
Diabetes mellitus	1
6–7 points: high 2-day risk (8%) 4–5 points: intermediate 2-day risk (4%) 0–3 points: low 2-day risk (1%)	

**Discharge after completion of diagnostic workup, latest after 24 h**

- begin secondary prevention
- long-term ECG (see scheme)
- Re-evaluation by general practitioner next day
- if indicated, neurovascular sonography
- neurological check-up after 2 weeks

# Diagnostic work-up

## Frequent causes

### Cardioembolism/paradoxical embolism

- Atrial fibrillation/flutter
- Myocardial infarction
- Other dysrhythmia (e.g. sick sinus syndrome, silent atrium)
- Valve disease
- Endocarditis

### Other causes

- Dissection (incl. aorta)
- Small artery disease (lacunar <1.5 cm + BG)
- Vasculitis
- Chronic infection (in particular HIV, Hep B/C, syphilis)
- Factor V Leiden/thrombophilia/anti-cardiolipin/lupus anticoagulant

### Paradox embolic

- PFO/ASD
- pulmonary shunt

- Acute coagulation disorders (especially DIC)
- Coagulation disorders associated with tumour
- Fabry disease

### Large artery disease

- Arterio-arterial embolism
- Aortic arch embolism
- Non atherothrombotic vasculopathy (e.g. FMD)

- Sickle cell disease/other haemolytic crises
- Polyglobulia/thrombocytosis
- Drugs
- Iatrogenic (e.g. periinterventional)

## Etiological DD according to results

### DD according to medical history and physical examination

- ? Circumstance at onset (e.g., Valsalva?)
- ? Positive familial history with onset < 40 years (Fabry disease, coagulopathy)
- ? < 50 years, previous art/ven thrombosis, abortion (anti-phospholipid syndrome), Fabry disease
- ? Throat/neck/eye pain, trauma (dissection ICA/VA)
- ? Headache (vasculitis), thunderclap headache (reversible vasoconstriction syndrome)
- ? Heart murmurs (endocarditis, valvular calcification)
- ? Angina pectoris (acute or in the past)
- ? Acute chest/back pain (aortic dissection!, coronary syndrome)
- ? Peripheral vascular examination incl. BP-difference left-right (aortic dissection)
- ? Skin lesions (septic emboli, Fabry: angiokeratoma, Sneddon: livedo racemosa)
- ? Vision disturbance + hearing disturbance (Susac's syndrome => corpus callosum affected?)
- ? Signs of systemic rheumatic disease
- ? B symptoms
- ? Acute or chronic infection

### DD according to laboratory results

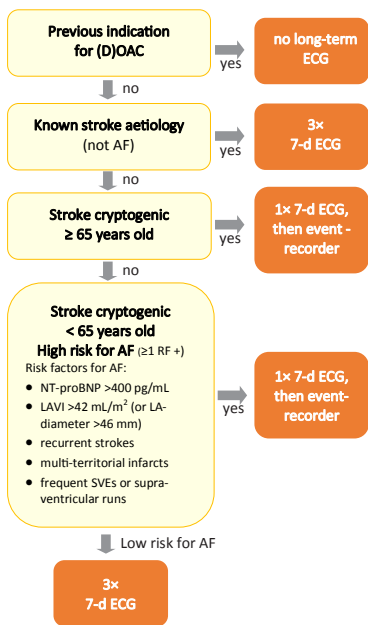
- Signs of infection: Infection-associated coagulopathy? Malignancy? Endocarditis? Systemic disease?
- Thrombocytopenia/Thrombocytosis, Leucocytopathy: haematological disease?
- Anaemia: Malignancy? Sickle cell anaemia?
- D-Dimer
  - < 500: more likely arterio-arterial, aorto-embolic, microvascular
  - 500–3000: associated with atrial fibrillation
  - > 3000: Malignancy? Coagulopathy?

### DD according to MRI

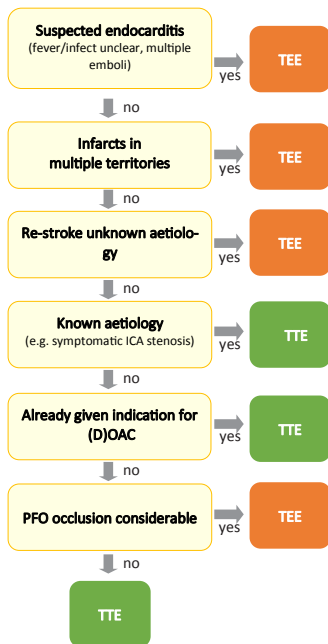
- > 2 vessel territories affected: cardio-embolic, aorto-embolic, coagulopathy (D-Dimer? Fibrinogen?), paradox embolic, vasculitis
- 1 vessel territory with multiple ischaemia: arterio-arterial (Plaque-MRI?)

- **MRI incl. MRA (for a reliable evaluation of the distribution pattern of acute/chronic infarction and determination of the etiology, especially in view of a CEA!);** if not possible, CT incl. CTA
- neurovascular ultrasound in the case of relevant stenosis or arterio-arterial embolization
- **12-lead ECG**
- **Long-term ECG** (see scheme below)
- **TEE** or TTE (see scheme below)
- **Routine laboratory testing:** Na, K, CRP, ESR, glucose, HbA1c, creatine, urea, hs-Troponin T, CK, CK-MB, AST, ALT, GGT, TSH, pro-BNP, D-dimer, complete blood count, coagulation state, blood lipids
- < 50 years: additionally lupus anticoagulant, anti-cardiolipin (IgG+M, not A!), anti-b2GPI (IgG+M, not A!) (if elevated after 3 months, repeat).

## Long-term ECG decision tree



## Echocardiography decision tree



# (A)symptomatic artery stenosis

## Criteria for the classification of symptomatic carotid artery stenosis:

- confirmation by a neurologist
- very likely: proof of a plaque rupture with apposition thrombus in CT/MR-angiography
- probable: internal carotid artery stenosis of at least 50% + typical stroke distribution pattern in MRI, with no other cause of the stroke (TEE/TTE and at least 24-hour ECG monitoring test)
- 

**In general:** CEA/stenting usually within a few days after symptom onset  
**- always high-dose statin therapy, for antiplatelet aggregation therapy see below**

### ICA stenosis extracranial

#### in case of CEA, elective:

- normally pre- and postoperative aspirin 100 mg or clopidogrel 75 mg monotherapy (stroke occurrence under aspirin or clopidogrel: consider aspirin 100 mg + clopidogrel 75 mg perioperatively)
- in case of additional atrial fibrillation, as long as anticoagulation is possible (depending upon infarct size): begin aspirin 100 mg 1 d preoperatively, therapeutic heparinization until surgery. After surgery: 7 d aspirin 100 mg + prophylactic heparin, then stop aspirin/heparin and begin (D)OAC

#### in case of stenting, elective:

- preinterventional aspirin 100 mg + clopidogrel 75 mg (possibly loading dose); postinterventional aspirin 100 mg + clopidogrel 75 mg for at least 6 months (depending on device type, result after stenting, follow up results), then monotherapy
- in case of additional atrial fibrillation, as long as anticoagulation is possible (depending upon infarct size): normally N(OAC) + aspirin 100 mg; start aspirin at least 1 day before intervention

#### In case of CAS (stenting) during acute intervention:

- Aspirin 250–500 mg i.v. during stenting, control imaging afterwards for exclusion of bleeding, then start Clopidogrel, 75 mg (preferably without loading or loading with only 150 mg)
- in case of brain perfusion is critically dependent upon stented ICA: control imaging after 6 h for exclusion of bleeding, then Clopidogrel (whenever possible with loading after weighing risk/benefit)

#### In case of apposition thrombus:

Stenosis > 50%: CEA/CAS as early as possible, consider transient therapeutic heparinization (1st choice LMWH) + statin high dose (for example, atorvastatin 80 mg)  
Stenosis > 50%: therapeutic heparinization (1st choice LMWH) + statin high dose; control MRI after 2 and 7 days; CEA/CAS in case of new ischaemia or persistent thrombus; in case of decrease of thrombus, consider conservative treatment

### Stenosis of vertebral artery origin

Stenting normally only in cases of failure of best medical treatment (including transient therapy with aspirin + clopidogrel)  
preinterventional aspirin 100 mg + clopidogrel 75 mg (possibly as loading dose)  
postinterventional aspirin 100 mg + clopidogrel 75 mg usually for 12 months with drug-eluting stents, otherwise 6 months; then monotherapy

### Intracranial artery stenosis

Aspirin 100 mg + clopidogrel 75 mg for 3 months, then de-escalate to monotherapy + statin at a high dose (for example atorvastatin 80 mg)  
Stenting should be performed only in exceptional cases and after failure of medical therapy

### Hyperperfusion syndrome:

- after revascularization of haemodynamically relevant stenosis there is a danger of hyperperfusion syndrome
- risk factors: high grade stenosis, bilateral stenosis, perioperative hypertension, diabetes, female sex, age > 75 years, reduced reserve capacity
- clinically: headache, seizures, neurological deficits; risk: intracerebral haemorrhage
- occurrence 12 h–7 d after revascularization
- therefore BP should normally be kept at < 140/100 mmHg postoperatively/postinterventionally
- in case of pronounced oedema poss. additional dexamethasone

	CEA	CAS (Stenting)
Anticipated interventional risk	individually	individually
Technical access	individually	individually
Malcompliance	pro CEA	
Prothrombotic status	pro CEA	
Bleeding tendency, previous bleeding under antiplatelet therapy	pro CEA	
Appositional thrombus with floating parts	pro CEA	
Severe renal insufficiency	pro CEA	
Re-stenosis after CEA/CAS		absolute indication
Post-radiation stenosis		absolute indication
Contralateral recurrence paresis		absolute indication
Contralateral carotid occlusion		pro CAS
Indication for (D)OAC with high embolic risk when paused		pro CAS
Mechanical heart valve		pro CAS

## Dissections

- According to current data the preventive effects of aspirin and OAC are probably comparable
- In cases of higher grade extracranial stenosis due to dissection or occlusions without large infarction or haemorrhagic transformations, consider OAC/therapeutic heparinization followed by OAC
- OAC is generally contraindicated in the case of intradural dissections or dissections extending intradurally (elevated risk for SAH)
- In the case of uncertain diagnosis with fat-suppressed T1 sequences in MRI: extend to regular diagnostic work-up after stroke
- Off-label use of DOAC can be considered in individual cases if OAC cannot be adjusted

- Duration of secondary prevention with aspirin/OAC: switch from OAC to aspirin after 3–6 months; continue aspirin 100 mg/d as long-term prophylaxis

## PFO

Occlusion of PFO in the case of cryptogenic stroke (at least TTE/TEE and one 7-day ECG negative) and/or RoPE score > 5 in patients < 60 years. The decision should be made individually and RoPE score serves as orientation. Consider circumstances that may facilitate paradoxical embolism (e.g. deep vein thrombosis, onset of neurological symptoms after Valsalva manoeuvre, co-existence of atrial septal aneurysm or eustachian tube (increase possibly recurrent risk) and poss. psychological factors).

**Antiplatelet aggregation inhibitors should be continued lifelong after occlusion of PFO.**

### RoPE score (risk of paradoxical embolism)

No hypertension	1	Age 18–29	5		Sum 0–3	0% PFO attributable risk
No diabetes mellitus	1	Age 30–39	4		Sum 4	38% PFO attributable risk
No previous stroke/TIA	1	Age 40–49	3		Sum 5	34% PFO attributable risk
Non-smoker	1	Age 50–59	2		Sum 6	62% PFO attributable risk
Cortical infarct localization	1	Age 60–69	1		Sum 7	72% PFO attributable risk
		Age ≥ 70	0		Sum 8	84% PFO attributable risk
					Sum 9	88% PFO attributable risk

# Cerebral vasculitides

<p><b>1</b></p> <p><b>History</b></p> <ul style="list-style-type: none"> <li>• B-Symptoms, recent infections</li> <li>• Headache <i>thunderclap, temporal/occipital pain</i></li> <li>• Visual, hearing impairment, eye-pain sicca symptoms</li> <li>• Oral/genital aphthae, sinusitis/epistaxis, asthma/cough</li> <li>• Reynaud, arthralgia, skin changes</li> <li>• Previous illnesses – <i>lymphoma/leukaemia</i></li> <li>• Immunosuppression <i>Diabetes, HIV, Immundefect</i></li> <li>• Medicaments <i>e.g. checkpoint inhibitors</i></li> <li>• Drugs <i>especially cocaine and amphetamines</i></li> <li>• Foreign travel/contact with animals/unpasteurized milk</li> <li>• Family History</li> </ul>	<p><b>2</b></p> <p><b>Status</b></p> <ul style="list-style-type: none"> <li>• General internal status</li> <li>• Auscultation over all large vessels</li> <li>• Palpitation of temporal arteries</li> <li>• Blood pressure at all extremities</li> <li>• Skin: <i>livedo, nailfold bleeding, distal emboli, angio keratoma</i></li> <li>• Joints: <i>redness, swelling, pressure sensitivity, hyperrelaxity</i></li> <li>• Eyes: <i>visual acuity, ocular fundus</i></li> <li>• ENT: <i>hearing test, Weber-/Rinne</i></li> </ul>
<p><b>3</b></p> <p><b>Blood</b></p> <ul style="list-style-type: none"> <li>• BSR, CRP, differential blood count, LDH, CK, liver, kidney, ferritin, calcium, TSH, immune fixation + free light chains in serum, IgG/M/A</li> <li>• Coagulation status including fibrinogen, D-dimer, lupus anticoagulant</li> <li>• RF IgM, CCP, ANA, ANCA, SS-A, SS-B, dsDNA, cardiolipin-/beta-2-glycoprotein-IgM/IgG, C3/C4</li> <li>• Urine drug screening</li> <li>• Infectious serology: HIV, hepatitis B, C, Lues, VZV, quantiferon test (before starting steroids, otherwise ELISpot)</li> <li>• If there is fever or increased CRP: 3x2 blood cultures (endocarditis scheme)</li> </ul>	<p><b>4</b></p> <p><b>Liquor</b></p> <ul style="list-style-type: none"> <li>• Standard including IEF</li> <li>• Cytology</li> <li>• If necessary, flow cytometry with CD4+/CD8+ quotient and haemat. Immune cell phenotyping</li> <li>• BioFire, CXCL13, liquor-/serum index for borreliosis, VZV, HSV (consider eubacterial/panfungal PCR)</li> <li>• Preserve 3 spare tubes (in case of suspected TBC one tube with 10 ml)</li> </ul> <p><b>Urine</b></p> <ul style="list-style-type: none"> <li>• Urine status, protein/albumin/creatinine quotient</li> <li>• in case of hematuria (WARNING bladder catheter) if necessary, urine sediment by nephrologist</li> </ul>
<p><b>5</b></p> <p><b>Additional examinations</b></p> <ul style="list-style-type: none"> <li>• MRI mit dark blood- and T1 space sequences, perfusion</li> <li>→ if inconclusive: cerebral angiography</li> <li>• nvUS intra- and extracranial vessels</li> <li>• &gt;45 y or ANCA+ : including temporal arteries; large vessel involvement → arm arteries</li> <li>• TEE</li> <li>• CT thorax (abdomen/pelvis if B-symptoms)</li> <li>• Consult ophthalmology: <i>If necessary fluorescence angiography, OCT angiography, vitreous puncture</i></li> <li>• If necessary, consult rheumatology</li> <li>• If necessary, consult infectiology eubacterial/panfungal PCR, next generation sequencing</li> <li>• Hole body PET in case of unclear large vessel affection /suspicion of sarcoidosis, lymphoma, small vessel vasculitis</li> </ul>	<p><b>6</b></p> <p><b>Biopsy CNS</b></p> <p>(diagnosis confirmed in 10–30%, alternative diagnosis in 30–50%)</p> <ul style="list-style-type: none"> <li>• Early pause of antiplatelet agents</li> <li>• target region: contrast enhanced non- eloquent areas; otherwise frontal lobe in non-ischemic area</li> <li>• sample: meninges + cortex + white matter</li> <li>• Analysis incl. bacteriology for detecting acid-fast rods, PCR mycobacteria, bacteria, fungi, in case of suspicion, also virus PCR</li> </ul> <p><b>Biopsy other body regions</b></p> <p>Evaluation before CNS biopsy (<i>eye, temporal arteries, nasal mucosa, lymph nodes, skin, muscle, nerve, kidney, lung, liver, bone marrow</i>)</p>

**Note: Small vessel vasculitis can only be detected with biopsy (MRA and DSA negative)**

Radiologically suggestive: multiple ischaemias (WARNING DD emboli, coagulopathy, intravascular lymphoma, MELAS, etc.).

Clinically suggestive: clinical findings clearly exceeding the detected ischemia.

WARNING DWI lesion without perfusion deficit → lymphoma?

### Primary cerebral vasculitis (PACNS)

(no pathognomonic clinical or paraclinical signs)

- **Clinic** headache (60%), cognitive deficits (50%), seizures (15%), rarely B-Symptoms
- **Blood** Elevated inflammation parameters (< 25%), otherwise normal
- **Liquor** Pleocytosis (50%), protein elevation (70%), intrathekal IgG
- **Radiology** ischemic lesions, hemorrhagic lesions (10%), contrast-enhancing lesions (30%), meningeal contrast enhancement (20%), arterial stenosis in MRA (55%) resp. DSA (75%)
- **Biopsy**

### Systemic vasculitis/inflammatory disease

- **Takayasu's arteritis**: < 50 years. Carotidodynia, brachial claudication, visual disturbance (retinopathy) → rheumatism (US of the large vessels), MRA thorax/abdomen or PET-CT (before steroid administration)
- **Giant cell arteritis**: > 50 years. B-symptoms, AION/ZAV, temp./occipital headache, intermittent claudication, arthralgia → rheumatism (US temporal artery and large vessels), MRA thorax/abdomen or PET-CT, biopsy temporal artery (before steroids)
- **Panarteritis nodosa**: HBV/HCV, B-symptoms, neuropathy/myalgia/CK ↑, arthralgia, palp. purpura/livedo, abdominal sulfamethoxazole, NI (no glomerulonephritis), microaneurysms → ANCA neg., abdom. angiography (aneurysms)
- **Kawasaki syndrome**: children, adolescents, fever, conjunctivitis/uveitis, mucous/skin changes, lymphadenopathy → clinical criteria
- **Granulomatosis with polyangiitis**: hypertrophic pachymeningitis, pituitary gland, cranial nerves/neuropathy/mononeuritis multiplex, sinusitis/otitis media, pneumopathy, kidneys (RPGN) → ENT (biopsy NNH), lung (Lufu), kidney (urine sediment)
- **Microscopic polyangiitis**: neuropathy/mononeuritis multiplex, livedo/palp. purpura, kidneys (GN), pneumopathy → nephro. (urine sediment)
- **Eosinophilic granulomatosis with polyangiitis**: mononeuritis multiplex, AION, sinusitis/otitis media, asthma, skin (subcutaneous nodules/ulceration/petechiae), kidneys (GN), eosinophilia → lab. (IgE), ENT (biopsy), lung (BAL, biopsy), kidney (urine sediment)
- **Cryoglobulinaemia**: haematological disorder (monoclonal Ig, MGUS, CLL, myeloma), chronic infection (HIV, HCV, HBV), autoimmune disease (SLE, Sjögren, RA); neuropathy, nephropathy, purpura → lab. (cryoglobulin)
- **IgA-vasculitis (Henoch-Schönlein purpura)** recurrent infection, purpura, arthralgia, abdominal pain, kidneys (GN) → IgA (elevated 50–70%), kidneys (urine sediment), biopsy skin/kidney if necessary
- **Goodpasture syndrome (anti-GBM disease)** kidneys (GN), alveolitis → lab. (Anti-GBM antibodies), kidneys (urine sediment), if necessary skin/kidney biopsy
- **Hypocomplementemic urticarial vasculitis (anti-C1q vasculitis)**: uveitis, urticaria, arthralgia, pneumopathy, abd. pain, kidneys (GN), → lab. (C1q/C3/C4), nephro. (urine sediment)
- **Behçet's disease**: brainstem, thalamus/basal ganglia affection, optic neuritis, CSF pleocytosis, thrombosis, oral/genital ulcers, (pan-)uveitis, skin lesion, arthritis → laboratory (HLA B51, IL-6), rheumatology (pathergy test)
- **Cogan's syndrome**: Eye redness/pain (interstitial keratitis), hearing impairment/vestibular symptoms, aortitis, recent infection/vaccination → ophtha, ENT (audiometry), neurootology
- **Rheumatoid arthritis**: (hypertrophy) meningitis, (compression) neuropathy, stiffness/polyarthritis, subcutaneous (+ cerebral) rheumatoid nodules, skin (palpable purpura, ulcer), → lab. (RF/CCP), rheumatology (ultrasound, puncture)
- **Sjögren's syndrome**: Neuro/ganglionopathy, HN, meningitis, myelitis, MS mimic, sicca symptoms, arthralgia/myalgia, skin (palpable purpura), kidneys (TIN) → lab. (cryoglobulin), rheumatology (Schirmer-/Saxostest, ultrasound parotid, biopsy)
- **Sarcoidosis**: Cranial nerves, Pachyleptomeninges, pituitary gland, med. lymphadenopathy, eosinophilia, liquor Glu ↓ Lac ↑, CT ACE, Vit. D, PTH, Ca+, liquor (sIL-2R, lysozyme, CD4+/CD8+-index), CT thorax, pneumo. (BAL with CD4+/CD8+-Index), PET-CT
- **IgG4-associated disease**: pachymeningitis, orbita, pituitary, neuropathy, periaortitis/arteritis, pancreas, salivary/gland → lab. (IgG4; 30% normal), biopsy of affected organ
- **Deficit of adenosine deaminase-2 (DADA2)**: adolescence, similar to c-PAN, skin, immunodeficiency (IgM ↓), anaemia/leukocytopenia → genetics

# DD Cerebral vasculitides

## Infectious diseases

- **Mycoplasma pneumoniae**: pneumonia, maculopapillary erythema, high erythrocyte sedimentation rate, haemolytic anaemia → *M. pneumoniae* PCR from TBS/liquor and serology, cold agglutinins
- **Bartonella henselae (cat scratch disease)**: cats, fever, lymphadenopathy, neuroretinitis, → *Bartonella henselae* serology (low specificity) and PCR (low sensitivity)
- **Thropheryma whipplei** farmers, GI symptoms, arthralgia, lymphadenopathy/B symptoms, myorhythmias/supranuclear gaze palsy → *T. whipplei* PSA staining and PCR CSF (PCR duodenum if necessary)
- **Rickettsial fever (Rocky Mountain spotted fever)**: N-/M-America, fever, headache, petechial rash, anaemia/thrombocytopenia/DIC → → serology
- **Leptospira**: contact with rats/mice/farm animals, field work/farmers, fever, kidney/liver involvement → serology
- **Brucella (Mittelmeerfieber)** raw milk/livestock, meningo-encephalitis, cranial nerve involvement, fever → serology/SAT in serum and liquor
- **Fungi**: Immunosuppression, aneurysms ICA, CAW), perforator strokes → galactomannan/1,3-beta-D-glucan in serum, BAL; culture from CSF; broad-spectrum PCR for fungi (panfungal PCR) if necessary (Unispital Zürich or Basel)

## Other

- **A $\beta$ -related angiitis (ABRA)/CAA-related inflammation (CAA-ri)**: Rapidly progressive dementia, marked leukoencephalopathy with enhancement, microbleeds/superficial siderosis → amyloid staining in biopsy

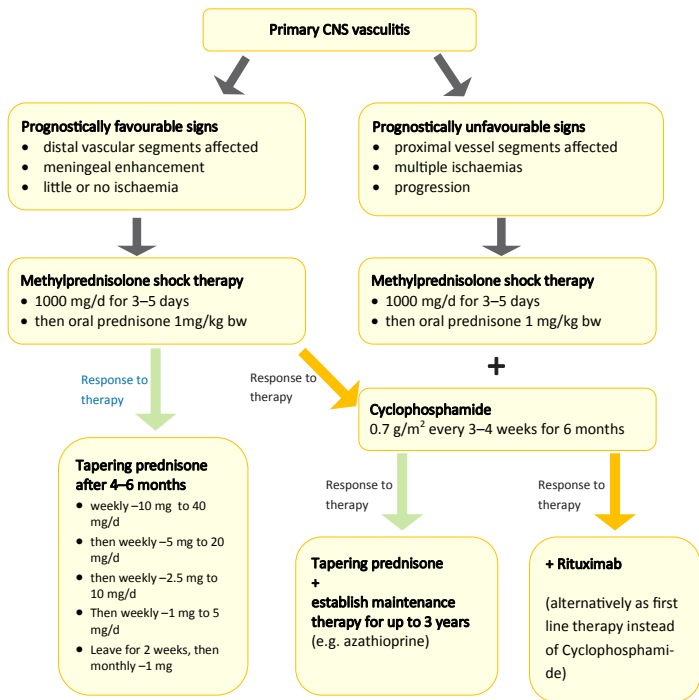
# Vasculitis Mimics

## with vascular changes in imaging

- **Atherosclerosis**: *large/medium vessels, vas. RF, CHD/peripheral arterial occlusive disease, normal CSF (NPV 80-95%), Asian origin, WARNING: also contrast agent-enhancement in MRI*
- **RCVS**: *see own chapter*
- **Vasospasm**: *e.g. drug-associated, SAH-associated*
- **Intravascular lymphoma (granulomatous cerebral vasculitis)**: DWI dysfunction without perfusion deficit, lymphadenopathy, B-symptoms, history → (intravascular) lymphoma → flow cytometry in serum and CSF (often unremarkable!), EBV serology and PCR, MRI spinal axis incl. cauda equina
- **Radiogenic Vasculopathy**
- **Fibromuscular dysplasia, Marfan-/Ehlers-Danlos Syndrome**
- **Divry van Bogaert-Syndrom, Sneddon's Syndrom** Livedo racemosa
- **Moya-Moya disease**

## without vascular change in imaging

- **Endocarditis**: fever, CRP-elevation, stigmata, microbleeds → BK 3x2 incl. HACEK group; if no pathogen *Coxiella burnetti* and *Bartonella henselae*; if aseptic (SLE?)
- **Multiple sclerosis/NMOSD/ADEM**
- **Posterior reversible encephalopathy syndrome (PRES)**
- **Lymphoma/glioma**
- **Susac syndrome**: Encephalopathy/CSMZ, sensorineural hearing loss, visual impairment/arterial branch occlusion, corpus callosum/periventricular lesions, leptomeningitis → ophtha. (fluorescence angio, OCT-A), ENT (audiometry)
- **Erdheim Chester disease**
- **Fabry disease**
- **CADASIL**: *Migraine with atypical aura, CVI/TIAs, Leukoencephalopathy (temporopolar, capsula externa)/lacunae before age 40 years → CADASIL → NOTCH3-gene*
- **RVCL (autosomal dominant retinal vasculopathy with cerebral leukodystrophy)**: *Retinopathy CVI/TIA, leukoencephalopathy, migraine, renal insufficiency → TREX 1-gene*
- **HERNS (hereditary endotheliopathy with retinopathy, nephropathy, and stroke)**
- **COL4A01-mutation**



# Cyclophosphamid scheme

## Strict verification of the indication

- confirmed CNS vasculitis or highest degree of suspicion despite negative biopsy (PACNS, severe inflammatory cerebral amyloid angiopathy ABRA / CAA-ri)
- CNS / PNS involvement in the context of systemic vasculitis, if without specific therapy

## Pre-treatment work-up

- Absolute contraindication: allergy, pregnancy / lactation, severe bone marrow depression, acute infection, severe urinary obstruction; relative: treated HIV, chronic Hep B, latent TBC, previous immunosuppressive therapy, etc.
- Declaration of consent from the patient / relatives
- Risk of infertility: conservation of egg cells (not immediately possible) / sperm, eventually GnRH agonist in cooperation with gynecology? Contraception guaranteed up to 6 months after the end of CYC (M and F)
- Clarification of vaccination status / latent infections: HIV, Hep B / C, VZV; HPV in patients with SLE <30y; possibly TBC (quantiferon test), syphilis, malaria, strongyloides, schistosomiasis, etc. for longer stays / origin from risk area / risk profile
- Vaccinations:
  - Renewal of regular vaccinations; usually pneumococcal vaccination (Prevenar13 once before the start of immunosuppression), if necessary Hep B according to the rapid scheme (d1, d7, d21 or 3rd vaccination after the end of CYC / before further immunosuppression, especially rituximab)
  - Recommendation for influenza vaccination for patients and the surrounding area once a year
  - Live vaccines (MMR, VZV, yellow fever, oral typhoid): only up to 4 weeks before immunosuppression (and from 6 months afterwards!)
  - Vaccination of those close to the patient, if the patient cannot be vaccinated (especially MMR, VZV, pneumococcus, influenza)
- Prophylaxis *Pneumocystis jirovecii* pneumonia with Trimethoprim f. 3x / week (if intolerance Dapsone or Atovaquone); if necessary, therapy for latent Hep B, TBC, Strongyloides etc. in consultation with Infectious Diseases
- Laboratory: blood count with differential, CRP, transaminases, creatinine, urine status, pregnancy test if necessary, IgG sub classes
- Chest X-ray (TBC)
- ECG (QTc for concomitant medication ondansetron)
- with suspected urination disorder residual urine, due to bladder toxicity from CYC!
- Important: interaction test (especially allopurinol, phenytoin, insulin / antidiabetic drugs, etc.)
- definition of parameters for follow-up assessment (clinical scores including neuropsychology, CSF, MRI / vasculitis sequences, DSA)

## Dose / administration

### DGN-Scheme for PACNS / ABRA (= Mayo Clinic / Austin scheme)

- Dose: CYC 750 mg/m<sup>2</sup> body surface; maximal dose per infusion: 1200 mg
- Time interval: every 4 weeks for a duration of 6 months
- no official scheme for dose adjustment to age and renal function

### Cyclops scheme (ANCA-associated vasculitis, if therapy with RTX is not preferred)

- Dose: CYC 15 mg/kg body weight; maximal dose per infusion: 1200 mg
- Administration pulse 1-3 every 2 weeks, then every 3 weeks
- Dose adjustment for age > 60Y and creatinine > 300 umol / l (Appendix)
- Dose adjustment of further doses depending on the leukocyte nadir:
  - Leukocyte nadir 1-2G / l: dose reduction by 40%
  - Leukocyte nadir 2-3G / l: dose reduction by 20%

## Controls / further pulse therapies

**Controls:** Laboratory: Day 10-14: blood count with differential («Leukocyte nadir»), CRP, transaminases, creatinine

### For every sequential pulse:

- Anamnesis: infection / cystitis complaints / hematuria; Laboratory: blood count with differential, CRP, creatinine, urine status, pregnancy test?
- Indication for interruption of therapy with cyclophosphamide:
  - Hematology: leukopenia <3000 / µl, granulopenia <2000 / µl, thrombopenia <100,000 / µl; aplastic anemia (distinguished from inflammatory and bleeding anemia)
  - Urology: non-glomerular hematuria / cystitis
- Documentation of the cumulative CYC dose in the diagnosis (increase in carcinogenicity, risk of hemorrhagic cystitis; maximum cumulative dose 20g)

## Re-evaluation

- Usually after 6 months aim for remission-maintaining therapy with alternative immunosuppression (e.g. azathioprine, methotrexate, rituximab); Avoid cyclophosphamide therapy > 12 months or cumulative dose of 25g.

# Reversible Cerebral Vasokonstriction Syndrome

## Symptoms

- typically thunderclap headache (in about 65%, sometimes with nuchal onset and then spreading to biparietal), lasting minutes to hours, rarely days; often persistence of a milder headache thereafter
- often accompanied by nausea, photophobia, phonophobia
- depending on severity, neurological deficits, epileptic seizures

## Typical triggers

- Sex, pressure, coughing, sneezing, urinating, bathing/showering, swimming, laughing, cannabis, cocaine, excess alcohol

## Liquor

- Cell count increase and protein increase possible → follow-up after 2 Wochen

## MRA/CTA/DSA

- typically: diffuse vasoconstriction with (almost complete); increase can still increase over weeks, reversibility within 12 weeks

## Diagnostic criteria

- acute and severe headache, often thunderclap headache with/without focal deficits or epileptic seizures
- monophasic course without new symptoms after >4 weeks course
- segmental vasoconstriction in CTA/MRA/DSA
- no aneurysmal SAH
- liquor normal or cell count <15 or protein <100 mg/dl
- complete or almost complete normalization of vasoconstriction within 12 weeks

## RCVS<sub>2</sub> score ≥ 5: PPV 98% NPV 67% sensitivity 94% specificity 86%

	Yes	No
Repeated or singular thunderclap headache	5	0
ICA intracranially affected	-2	0
Vasoconstrictive trigger present	3	0
Female sex	1	0
Subarachnoid haemorrhage	1	0

## Complications

- Convexity SAH (non-aneurysmal)
- ICH
- Ischemias, especially watershed infarcts
- Reversible encephalopathy syndrome
- Brain edema

## Therapy

- No established treatment; consider: nimodipine, verapamil, magnesium sulfate

# Cerebral venous and sinus thrombosis

- etiological work-up: infectious, coagulation disorder

- **LMWH in therapeutic dosage:** e.g. enoxaparin (1mg/kg bw, 2x/d) (a non-randomized study even showed superiority in respect to efficacy and hemorrhagic complications; especially in patients with congestion hemorrhage)

- **alternatively therapeutic heparinization** (aPTT 1.5-2.5x baseline aPTT)

particularly in patients with risk of craniectomy; **switch to OAC in the course of time**

- alternatively Dabigatran can be considered

CAVE: anticoagulation is contraindicated in Behçet's disease

- continue therapeutic heparinization/LMWH also after occurrence of congestion hemorrhages

- IVT or mechanical recanalization in exceptional cases or in studies (e.g. TO-ACT)

- in case of large hemorrhagic infarctions and impending lateral herniation: decompressive craniectomy as early as possible without removal of hematoma or infarcted tissue

- **duration of OAC 6 months** (except in case of progressive thrombosis at follow-up MRI or known thrombophilia)

- usually examination for coagulation disorders after stopping OAC

## Therap. heparinization unfractionated heparin

- **complete baseline coagulation status before start of therapeutic heparinization**

- if baseline aPTT is abnormal (normal: 26-37sec) or in case of extensive thrombosis, consult a hematologist and control anti-factor-Xa-activity (aim 0.3-0.6 U/ml)

- usual aPTT aim: 1.5-2.5x baseline aPTT

- strictly check thrombocytes every 2 days during the course of therapy (HIT? => 4Ts score)

The following dosage scheme is for patients at the Insepsital with low bleeding risk. Depending on infarct size, the dosage should be reduced individually.

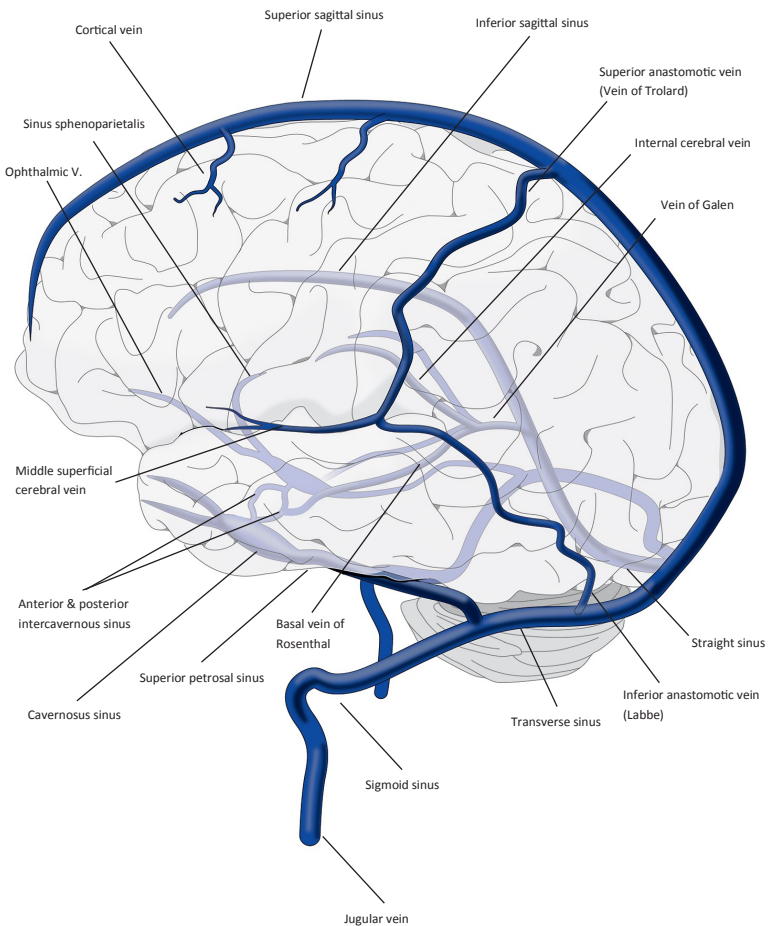
### Therapy start

Bolus 60-70 U/kg (max. 5000U)  
i.v. continuously 12-15 U/kg/h (max. 1000 U/h)

Re-evaluation after 6h

### Dosis adaption in dependence on aPTT and Anti-Xa

aPTT	Anti-Xa		
< 35 sec	< 0.2 U/ml	Bolus 40 U/kg Increase infusion rate by 3 U/kg/h	Re-evaluation after 6h
36-45 sec	0.2-0.29 U/ml	No bolus, increase infusion rate by 1.5 U/kg/h	Re-evaluation after 6h
46-70 sec	0.3-0.7 U/ml	No change	Re-evaluation after 6h, then 1x/day
71-90 sec	0.71-1.0 U/ml	Reduce infusion rate by 1.5 U/kg/h	Re-evaluation after 6h
> 90 sec	> 1.0 U/ml	Pause infusion for 1 h then reduce by 2-3U/kg/h (if aPTT >200sec pause infusion for 2h)	Re-evaluation after 6h



# Secondary prevention

Etiology	First stroke	Re-Stroke → always repeat or escalate examinations for etiology
<b>no reason determined (specially no cardiac embolism source, no symptomatic stenosis)</b>	ASS 100mg or Clopidogrel 75mg or ASS+Dipyridamole (Asasantin®) Ticagrelor (Brilique®) in case of intolerance to the other agents	Change to Clopidogrel 75mg or ASS+Dipyridamole (Asasantin®)  Ticagrelor (Brilique®) in case of intolerance to the other agents
	<b>Initial therapy:</b> in case of TIA or minor stroke within 24h after symptom onset and NIHSS < 4, small infarct): 4 weeks ASS 100mg + Clopidogrel 75mg (loading 600mg) when hemorrhagic transformation is excluded and individual bleeding risk is not elevated	
	If additionally CHD, peripheral arterial occlusive disease or asymptomatic carotid artery stenosis: rivaroxaban (Xarelto®) 2x2.5mg + ASA 100mg/d instead of aspirin monotherapy	
<b>non-valvular AF</b>	- DOAC - occurrence under sufficient or insufficient OAC => change to DOAC - occurrence under DOAC: change substance class (Xa ↔ IIa) -consider atrial appendage closure	- occurrence under sufficient or insufficient OAC => change to DOAC - occurrence under DOAC: change substance class (Xa ↔ IIa) -consider atrial appendage closure
<b>valvular AF (Def: AF with rheumatic mitral stenosis)</b>	OAC INR 2-3	1. optimize dosage if necessary 2. consider OAC INR 2.5-3.5 3. consider OAC + ASS 100mg
<b>symptomatic extracranial carotid stenosis</b>	>50% degree of stenosis: CEA/CAS < 50% with radiologically proven plaque rupture: individual + statin at high dose	< 50% stenosis with radiologically proven plaque rupture: consider CEA/CAS
<b>symptomatic extracranial vertebral artery stenosis</b>	ASS 100mg + 4 weeks Clopidogrel 75mg + statin at high dose Contralateral hypoplasia: consider stenting	consider stenting
<b>symtomatic intracranial stenosis</b>	ASS 100mg + Clopidogrel 75mg for 3 months, then monotherapy + statin at high dose	ASS 100mg + Clopidogrel 75mg (duration individually) + statin at high dose + consider stenting

## Instructions for the initiation of antiplatelet aggregation therapy after ischemic stroke

- in case of conservative treatment: immediately
- after mechanical EVT: usually immediately with loading (250-500mg ASS or 300-600mg Clopidogrel)
- after IVT, Bridging, Urokinase i.a.: after exclusion of bleeding in 24h control imaging
- in case of imminent space-occupying brain edema neurosurgeons should be involved immediately. If a potential craniectomy is considered, no administration of antiplatelets (see separate guidelines).

## Instructions for the earliest initiation of (D)OAC after Ischemic stroke

- CAVE: Exclude hemorrhagic transformation and endocarditis (=contraindications)
- TIA/smallest infarctions: immediate initiation
- Small infarction (≈ <40ml): after 3d (with BG involvement 6d)
- Middle-sized infarction (≈ 40-100ml): after 6d (with BG involvement 9d) after exclusion of hemorrhage
- Large infarction (≈ >100ml): after 12d (with BG involvement 15d) after exclusion of hemorrhage
- usually no intermediate antiplatelet therapy until start of (D)OAC
- in case of medication switch: consider transient „dual therapy“ depending on the delayed loss of therapeutic effect depending on T<sub>1/2</sub>
- highly embolic source of embolism (e.g. mechanical heart valve): consider immediate initiation of a therapeutic heparinization except if infarction is very large or hemorrhagic
- in case of hemorrhagic transformation, initiation usually after 2 weeks (following CT scan)

≈40ml



≈100ml



## Secondary prevention in special situations

### Myocardial infarction (sub)acute

- consider DOAC application for 3 months also without thrombus finding, esp. with embolic infarct distribution
- stenting in patients with (D)OAC indication → (D)OAC + clopidogrel (consider DOAC low dose in large infarctions), triple therapy in acute stroke only in exceptional cases (esp. in-stent-thrombosis, stent main stem)
- If AF is indication for (D)OAC: consider atrial appendage closure, afterwards only dual antiplatelet therapy
- STEMI: Coro immediately; NSTEMI: Coro as soon as clopidogrel + ASS or (D)OAC + clopidogrel is possible (depending on indication); Coro immediately in case of severe arrhythmia, hemodynamic instability, persistent pain

### Detection of AF or atrial thrombus in patients taking aspirin + clopidogrel due to coronary stent

DOAC long-term therapy + usually 1 year clopidogrel; during dual therapy consider (transient) DOAC low dose in dependence on infarct size

### Intracardial thrombus

Ventricular: (D)OAC for 3 months, then control TEE and consider change to antiplatelet therapy  
Atrial appendage thrombus: DOAC therapy life long also without proven AF

### Symptomatic stenosis

see page 18

### Coronary heart disease or peripheral arterial occlusive disease + high risk for ischemic events

Consider Rivaroxaban 2x2.5mg + ASS 100mg/d

### Severe heart failure with severe hypokinesia/akinesia

No DOAC except in case of intra cardiac thrombus

### Infectious Endocarditis

No antiplatelet therapy/heparin/(D)OAC; if valvular replacement is indicated, early operation seems to be beneficial

### Pulmonary embolism

DOAC, start depends on infarct size; duration: 6 months in case of unequivocal provocative factors (surgery, immobilization >48h, plaster cast on leg), otherwise long-term therapy;  
PFO occlusion in case of long-term DOAC therapy not indicated, otherwise PFO closure also with low RoPE score

### Paraneoplastic Coagulopathy

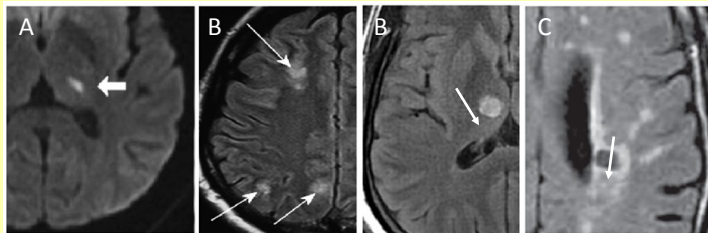
LMWH therapeutic dosage (2x/d, not 1x/d) or Edoxaban or Rivaroxaban

# Silent strokes

- most frequent incidental finding in CT/MRI (no TIA or stroke suspicious episodes in medical history)
- prevalence depending on cardiovascular risk profile and age (~30% in people aged 70)
- increased stroke risk and severity, risk for dementia, depression and subclinical deficits

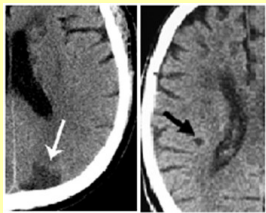
## Definition by MRI

- acute or subacute ischemia (see A, p.e. acute diffusion lesion with signal decrease in ADC and without symptoms and without otherwise explanation)
- chronic ischemia:
  - T2/FLAIR hyperintense lesion, T1 hypointense lesion non-lacunar (see B)
    - ◊ cerebellar or supratentorial cortical, or
    - ◊ supratentorial subcortical >3mm with affection of deep gray matter and without otherwise explanation
  - lacunar lesion (see C):  $\geq 3\text{mm}$ , not corresponding to enlarged perivascular space



## Definition by CT

- cortical defect zone or lacunar lesion



## Diagnostics

- search for risk factors
- complete vessel imaging if not already done with initial imaging
- 3x 7d ECG
- TTE/TEE

## Therapy

- risk factor treatment
- ASS with consideration of risk/benefit value
- treatment of blood pressure equal to secondary prevention guidelines,
- consider treatment of stenosis > 60% of the depending vessel after consideration of risk/benefit value, in case of
  - acute ischemia, or
  - multiple chronic ischemia in the corresponding vessel territory

# Direct oral anticoagulants (DOAC)

- indicated in strokes with evidence of non-valvular AF
- in cerebral venous thrombosis and dissection: phenprocoumon/acenocoumarol **or dabigatran**
- not recommended in anti-phospholipid-antibody syndrome or valvular AF (valvular: rheumatic mitral stenosis)
- in case of known elevated GIT bleeding risk: preferable lower doses of DOAC especially in patients > 75 years

	Factor II-inhibitor	Factor X-inhibitors		
	Dabigatran (Pradaxa®)	Apixaban (Eliquis®)	Rivaroxaban (Xarelto®)	Edoxaban (Lixiana®)
<b>General Information</b>	CI: Child-Pugh A-C	CI: Child-Pugh C	CI: Child-Pugh B+C	CI: Child-Pugh C
<b>Dose if CrCl ≥ 50 ml/min</b>	2 x 150mg (≥ 80 years: 2x110mg)	2 x 5mg  (2 x 2.5mg if two of the following criteria are fulfilled: ≥80 years, ≤60kg, creatinine ≥ 133 µmol/l)	1 x 20mg	1 x 60mg (1 x 30mg if bw < 60kg)
<b>Dose if CrCl 30-49 ml/min</b>	2 x 110mg		1 x 15mg	1 x 30mg
<b>Dose if CrCl 15-29 ml/min</b>	contraindicated		1 x 15mg, control of plasma coagulation recommended	1 x 30mg
<b>Dose if CrCl &lt;15 ml/min</b>	contraindicated	not recommended	contraindicated	not recommended
<b>Inductors (effect diminished)</b> (bold print: contraindication)	Rifampicin, St John's wort, carbamazepine	Rifampicin (edoxaban: dosage reduction not necessary), phenytoin, carbamazepine, phenobarbital, St John's wort		
<b>Inhibitors (effect enhanced)</b> (bold print: contraindication)	Verampil, <b>ketoconazole, itraconazole, voriconazole, HIV-protease inhibitors, quinidine, dronedarone, ciclosporin, tacrolimus</b> , amiodarone	Verapamil, ketoconazole, itraconazole, voriconazole, posaconazole HIV-protease inhibitors		
<b>T<sub>1/2</sub></b>	12-17h	9-14h	5-9h	10-14h
<b>Set off time before surgery</b> (in agreement with surgeon)	24h up to 72h in case of large operations 4d with CrCl < 50ml/min	24h 48h in case of high bleeding risk, renal failure, elderly patients	24h 48h in case of high bleeding risk, renal failure, elderly patients	24h before 48h in case of high bleeding risk, renal failure, elderly patients

# Risk factors

Responsible for 9/10 Strokes	Responsible for 4/5 Strokes	Hypertension (>140/90 mmHg)
		Lack of physical activity (< 150min/week moderate or <75 min intensive exercise)
		Overweight (BMI >25, abdominal girth >m:94cm/f:88 cm)
		Unhealthy diet
		Dyslipidemia
	Smoking (incl. pipe, cigars)	
	Psychosocial stress	
	Alcohol abuse (> 30 drinks/month; f>15g/d, m>30g/d)	
	Diabetes mellitus (fasting blood sugar $\geq$ 7mmol/l, HbA1c $\geq$ 6.5%); impaired fasting glucose: 5.6-6.9mmol/l	
	Family history (m <55 years, f<65 years)	
	Pre-stroke/TIA	
	Sleep related breathing disorders	
	Depression	
	Migraine with aura (at least 2 auras in a lifetime)	
	Pregnancy	
	Atrial tachycardia	
	Tachycardia at rest	
	Increased variability in blood pressure	
	Cardiac wall motion abnormalities	
	Contraception	
Hormone replacement therapy		
Acute infection (esp. influenza)		
Chronic renal failure		

## Risk stratification

Risk	Criteria	SCORE risk chart
Very high risk	<ul style="list-style-type: none"> <li>Previous vascular event: cerebral stroke, myocardial infarction, symptomatic peripheral arterial occlusive disease</li> <li>Detection of atherosclerotic plaques, silent ischemia</li> <li>Previous revascularization of an artery</li> <li>Diabetic patients with end-organ damage (e.g., microalbuminuria) or <math>\geq</math>three major risk factors or disease duration &gt;20 years</li> <li>Severe renal insufficiency (GFR&lt;30 ml/min./m<sup>2</sup>)</li> <li>Familial dyslipidemia with a risk factor</li> </ul>	>10%/10 years
High risk	<ul style="list-style-type: none"> <li>1 poorly controlled risk factor (e.g., LDL cholesterol &gt;4 mmol/L, tricycerides &gt;8 mmol/L, or BP <math>\geq</math>180/110 mmHg)</li> <li>Familial dyslipidemia without poorly controlled risk factor</li> <li>Diabetic patients <math>\geq</math>10 years of disease duration, without end-organ damage and without additional risk factors</li> <li>Moderate renal insufficiency (GFR 30–59 ml/min./m<sup>2</sup>)</li> </ul>	5–10%/10 years
Moderate risk	<ul style="list-style-type: none"> <li>Young diabetics (if type 1 diabetes &lt;35 years, if type 2 diabetes &lt;50 years) with a duration of disease &lt;10 years, without other risk factors</li> </ul>	1–5%/10 years
Low risk	No criteria met	<1%/10 years

## Stepwise drug treatment

1. Monotherapy in: >80 yrs. u/o frail patients, low vascular risk, AH grade 1, high normal blood pressure and high/very high risk
2. Otherwise dual combination therapy, 1st choice ACE inhibitor/sartan+calcium channel blocker or ACE inhibitor/sartan+diuretic; in case of beta-blocker indication (angina pectoris, post myocardial infarction, heart failure, rhythm control): combination of beta-blocker + other antihypertensive (ACE inhibitor, sartan, calcium antagonist, diuretic)
3. Triple combination therapy (sartan + diuretic + calcium antagonist): if max. dose of dual combination therapy is insufficiently effective
4. Spironolactone in the absence of contraindications (including GFR <45 mL/min., potassium >4.5 mmol/L) and insufficiently effective triple combination therapy
5. Alternative/supplementary classes of hypertensives (e.g., alpha-1 blocker) in case of insufficient efficacy of the above-mentioned combinations of antihypertensives, or intolerance

## Notes

- Blood pressure variability significantly increases stroke risk → calcium antagonists
- Caution is needed in the case of vascular occlusion and/or high-grade stenoses (if necessary, higher target values/slower decrease)
- All antihypertensives can be combined in any way, except sartans and ACE inhibitors
- GFR <30ml/min.: thiazide diuretics are not effective

## Secondary arterial hypertension

Look for in the case of resistance to therapy (especially in patient <75 years, normal weight, healthy lifestyle, absence of diabetes mellitus and/or organ damage due to vascular risk factors)

- Causes: sleep-associated respiratory failure, primary hyperaldosteronism, chronic renal failure, pheochromocytoma, fibromuscular dysplasia, coarctation of the aorta, Cushing's syndrome, Hyperparathyroidism, medications (oral contraceptives, sympathomimetic mucosal decongestant therapy, NSAIDs, cyclosporine, erythropoietin, chronic steroid therapy, chemotherapeutic agents), drugs (cocaine, amphetamines, anabolic steroids), other substances (licorice)

	Systolic	Diastolic	Recommendations
<b>Optimal</b>	<120	<80	-
<b>Normal</b>	120–129	80–84	-
<b>High-normal</b>	130–139	85–89	< 65 years, low/moderate risk: primarily non-drug therapy < 65 years, high/very high risk: drug + non-drug therapy ≥ 65 years: primarily non-drug therapy
<b>AH grade 1</b>	140–159	90–99	<80 years, low/moderate risk: Combined non-drug (focus) and drug therapy < 80 years high/very high risk: intensive drug and non-drug measures ≥ 80 years: primarily non-drug measures
<b>AH grade 2</b>	160–179	100–109	Combined non-drug and drug therapy (>80 years especially with good AZ)
<b>AH grade 3</b>	≥ 180	≥ 110	Combined non-drug and drug therapy (>80 years especially with good AZ)
<b>Isolated systolic AH</b>	> 140	and < 90	Non-drug therapy + regular check-ups

# Physical inactivity

Physical activity has a beneficial effect on vascular risk factors, has antidepressant effects and promotes smoking cessation

**Recommendation:** at least 20–60 min. exercise on 3–5/days per week of at least moderate intensity (e.g. walking, jogging, swimming, cycling)

(specific recommendation for high blood pressure: 60–90 min./week, weight reduction: 225–420 min./week, diabetes: 150 min./week)

- 8% of all deaths are related to physical inactivity
- 28% reduction in relative risk of stroke, myocardial infarction and vascular fatality with physical activity (compared to 22% with ASA, 21% with statins, and 21% with antihypertensives)
- Stroke risk reduced by 30% with >40min of moderate/high intensity activity 3–4x/week

# Dyslipidemia

## Important notes

The treatment of dyslipidemia and the success of the scheme below requires careful pre-selection of patients. NO mandatory statin therapy is needed, for example, in patients with dissection, confirmed paradoxical embolization, iatrogenic strokes, etc. In these cases, the indication would be with the criteria for primary prevention (not listed here).

## Stepwise therapy

1. Choice of statin, increasing dose as long as target value not reached and up to highest tolerated dose.

**If target value is not reached:**

- Statin+ezetimib (Inegy®) and if necessary PCSK9 inhibitors, especially in the case of very high vascular risk
- If necessary, anion exchange resin
- If necessary, fibrates in hypertriglyceridemia

**In cases of statin intolerance:** switch to another statin, if necessary, ezetimib (Inegy®) +/-PCSK9 inhibitors

- Strenth: rosuvastatin (Crestor®) > atorvastatin (Atorva®, Atorvastatin®, Sortis®) > simvastatin (Simcora®, Simvasin®, simvastatin®, Zocor®) > pravastatin (Pravastatin®, Mevalotin®) > fluvastatin (Fluvastatin®, Lescol®)

## General

- For every 1 mmol/L increase in total cholesterol, relative risk of ischaemic cerebral infarction increases by 25%
- In cerebral infarction associated with atheromatosis, achievement of a target LDL cholesterol <1.8 mmol/L shows a better prognosis than a target of 2.3–2.8 mmol/L
- For symptomatic/multiple stenoses/significant atheromatosis of the aorta: usually a high dosage (e.g. atorvastatin 80 mg), target LDL value: < 1.4 mmol/L
- PCSK 9 inhibitors: evolocumab (Repatha®), alirocumab (Praluent®)
- Statin-induced immune-mediated necrotizing myopathy, 5-year incidence on atorvastatin 40 mg/d: 5/10 000

## Target values

Vascular risk: (see p.28)	Low	Moderate	High or arteriosclerosis detected	Very high or symptomatic stenosis
LDL	Target <3mmol/L	Target <2.6mmol/l	Reduction of baseline value by >50% Target <1.8 mmol/L	Reduction of baseline value by >50%. Target <1.4 mmol/L
Non-HDL cholesterol (TG-HDL)		Target <3.4mmol/L	Target <2.6mmol/L	Target <2.2mmol/L
TG			Target <1.7 mmol/L	

## General

- Recommended target value of HbA1c <7%
- Avoid hypoglycaemia, as it increases vascular risk
- Target value of blood pressure in patients with diabetes: <65 yr <130/80 mmHg, >65 yr <140/80 mmHg
- in case of high/very high risk (see below): aspirin 100 mg/day possibly already part of primary prophylaxis

## Risk stratification in patients with diabetes

**Very high risk:** Diabetes mellitus + vascular clinical event or organ damage that has already occurred, or >3 other vascular risk factors, or type 1 diabetes mellitus with a duration of >20 years

**High risk:** Duration of disease >10 years without organ damage but with at least one additional vascular risk factor (Forxiga®) and GLP-1 receptor antagonists (e.g. liraglutid (Victoza®), semaglutide (Ozempic®), dulaglutid (Trulicity®))

**Moderate risk:** Young patient with diabetes mellitus type 1, and <50 yr for patient with diabetes mellitus type 2, with short duration of disease (<10 years) and no other vascular risk factors

## Medications

- Choices in patients with type 2 diabetes mellitus:
  - 1st choice metformin
  - 2nd choice SGLT2 inhibitor (e.g. empagliflozin (Jardiance®), Canagliflozin, Invokana®), dapagliflozin (Forxiga®) and GLP-1 receptor antagonists (e.g. liraglutid (Victoza®), semaglutide (Ozempic®), dulaglutid (Trulicity®))
- In patients with atheromatosis or high vascular risk: 1st choice metformin; low-threshold addition of an SGLT2 inhibitor or GLP-1 receptor antagonist (lower risk of vascular events, mortality)
- Metformin
  - GFR <45 mL/min.: no restart; if already prescribed → dose reduction (up to 500mg/day) with regular GFR checks (2–3x/year)
  - GFR <30 mL/min: stop metformin
  - Do not start with metformin in a patient with vit. B12 deficiency (metformin inhibits the absorption of vit. B12)
- SGLT2 inhibitors
  - Use only if GFR>45ml/min
  - Side effects: urogenital infections are common. Data limited for age >75 yr
- GLP-1 receptor antagonists can be used if GFR<30ml/min., but only when BMI >28 kg/m<sup>2</sup>

## Sleep apnoea syndrome

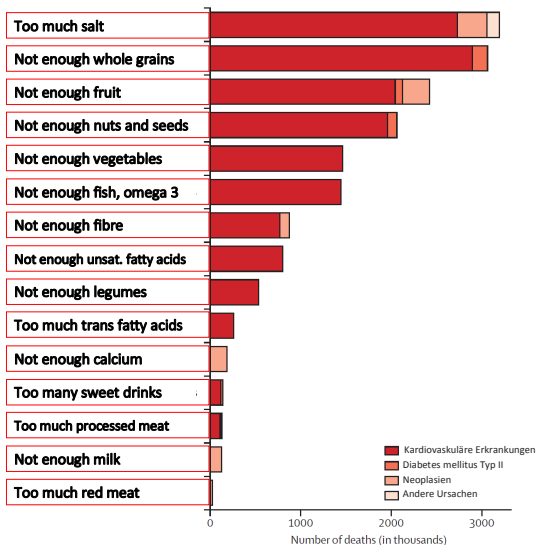
- Screening with respiratory polygraphy or Apnea link

- Treatment with CPAP/APAP/ASV indicated with

1. AHI ≥ 5/h in symptomatic SAS (preexisting sleepiness)
2. AHI ≥ 30/h also in asymptomatic SAS
3. AHI 5-29/h + relevant general medical indications (e.g. severe heart failure, untreatable arterial hypertension)

# Diet

- **Recommendation:** consumption of fresh fruits, vegetables (the more the better, i.e.  $\geq 3$  servings/day).  $\geq 5$  servings: risk reduction 26% (RR 0.74; 95% CI 0.69–0.79;  $p < 0.0001$ ). 3–5 servings: risk reduction 11% (RR, 0.89; 95% CI 0.83–0.97;  $p = 0.005$ ).
- Beneficial effect of **Mediterranean diet** (consumption of legumes, whole grains, low-fat dairy products, fish, unsaturated fatty acids): risk reduction 44%
- Beneficial effect of **DASH diet** (low-fat diet rich in minerals, vitamins and whole grains): risk reduction 25%
- **Salt consumption**  $< 5$  g/day; reduction by 1 teaspoon/day: risk reduction 30%
- Consumption of **coffee** has a beneficial effect (U-shaped curve for association with risk of stroke, max. 3–4 cups/day associated with 17% risk reduction)
- Consumption of **tea** (green and black) has a beneficial effect (risk reduction of 13% with intake of 3 cups/day)
- Consumption of **chocolate** has a beneficial effect
- Max. **alcohol** consumption  $< 14$  units/week for men and  $< 8$  units for women (1 unit=250 ml beer or 125 ml wine); avoid binge drinking.
- Avoid drinks with refined sweeteners
- Unfavourable effect of saturated fatty acids
- Questionable or very small unfavourable effect of red meat



Adapted according to GBD 2017 Diet Collaborators. Lancet

- Target BMI <20–25kg/m<sup>2</sup>
- Target abdominal circumference: men: < 94 cm, women: < 80 cm
- Stroke mortality increases by 40% per 5 kg/m<sup>2</sup> increase in BMI

## Smoking

- Smoking cessation: medical counselling, self-help interventions, group behavioural therapy, telephone counselling, medications (e.g., bupropion, clonidine) are effective
- For addresses of advisory centres see [www.stop-tabak.ch](http://www.stop-tabak.ch)

# Non-traumatic intracerebral haemorrhage (ICH)

## Interdisciplinary Management

Conservative Management → Neurology

OP-Indication → Neurosurgery

- Evaluation of therapy requirements at an early stage
- Positioning: upper body elevation usually at least 30°, otherwise free mobilization
- Discontinuation: antiplatelet agents, (D)OACs and heparins

Emergency  
ward

## A B C D Care

**A**

Reverse Anticoagulation      Begin <15 minutes after diagnosis on CT/MRI  
See next page for the scheme

**B**

Reduce blood pressure      Begin <15 minutes after diagnosis on CT/MRI  
if >160/90mmHg

Blood pressure target ≤ 140/90mmHg within 1h after admission

- Important:** a) Avoid fluctuations of >20% → early perfusor  
b) Avoid reduction of >60mmHg in the first hour

• Medication:

1. Choice: Uradipil (Ebrantil®) 5–10 mg i.v. bolus-wise, 5–40 mg/h via perfusor
2. Choice: Labetalol (Trandate®) 20–80 mg i.v. bolus-wise, 1–2 mg/min via perfusor, maximum 2.4 g/day
3. Choice: Clonidine ( Catapresan®) 25–500 mg i.v. bolus-wise. Avoid: i.v. nitrate derivatives (possible negative effect).

**C**

NCH-intervention      Rapid evaluation by neurosurgeon regarding indication for surgery (<30 minutes after diagnosis on CT/MRI)

- Individual decision on haematoma evacuation in non-basal ganglia haemorrhage with GCS 9-13.
- No indication for surgery in case of basal ganglia hemorrhage, if necessary include in SWITCH study
- Ventricular drainage in the case of cerebrospinal fluid circulation disorder

**D**

Diagnostics      See clarification algorithm

- Blood pressure measurement on an outpatient basis <130/90 mmHg; instruct patients in self-measurement and documentation (bring findings to consultation)
- Evaluation/restart of antithrombotics: consultation (see scheme)

**3-month check-up**

MRI if not performed in acute phase

**12-month check-up**

Incl. MRI (registration "ICH/microangiopathy")

**Annual follow-ups**

- only for selected patients
- under OAC according to ICH
- high cerebrovascular risk
- Individual indications for imaging

Neuro-  
IMC/  
Stroke  
Unit

depending  
on OP  
indication  
and capacity

ICH  
consultation

# Anticoagulation/antiplatelet-associated ICH

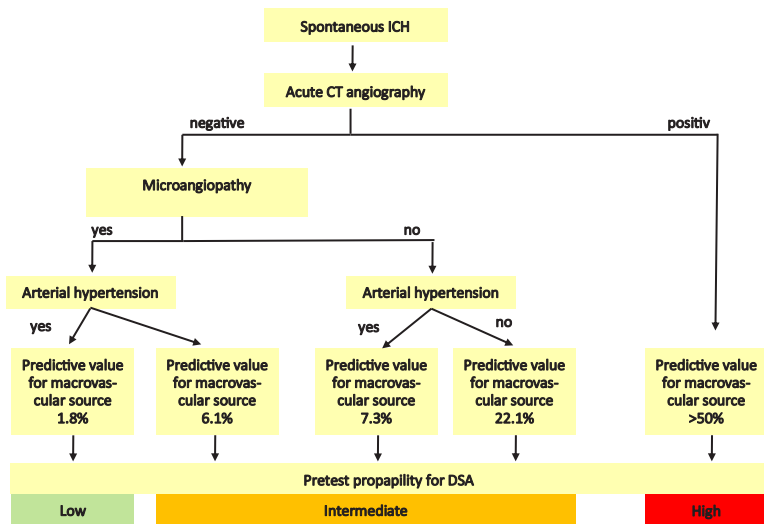
**Always:** stop antiplatelet therapy/(D)OAC/heparines

Anticoagulant	Therapy	Note
Alteplase	See also page 14 → <b>Fibrinogen (Haemocomplettan P)</b> or <b>Prothrombin complex concentrate</b> (involve haematology) → <b>Tranexamic acid (Tranexam OrPha)</b> i.v. <b>1000 mg over 10 min</b> → <b>blood pressure target <math>\leq 140/90</math> mmHg</b>	See page 14
Phenprocoumon	Prothrombin complex concentrate: 2400 IE (if < 50 kg body weight: 30 IE/kg body weight) + vitamin K: if INR $\geq 1.5$ → 10 mg i.v., then dosage in dependence on INR; onset of drug effect approx. 4-6h	Repeat prothrombin complex concentrate in case of insufficient INR decrease after 15min. Then INR at least 1x/d (and eventually repeat vitamin K
Heparin UFH	Protamine sulfate: <u>If Heparin was stopped <math>\leq 1</math>h or anti-Xa activity <math>\geq 0.35</math>:</u> 1000 E i.v. (1ml) per 1000 E heparin given during the last 3 hours (max. 5000E); <u>If Heparin was stopped 1–3h before or anti-Xa activity 0.15–0.35:</u> 500 E i.v. (0.5ml) per 1000 E heparine given during the last 3 hours (max. 5000E)	Involve haematology; beware of contraindications!
Heparin LMWH	Protamine sulfate: <u>Last therapeutic dosage given <math>\leq 8</math>h or anti-Xa activity <math>\geq 0.5</math>:</u> 5000 E protamine sulfate <u>Last therapeutic dosage given 8–12h or anti-Xa activity 0.3–0.5:</u> 2500 E protamine sulfate	Involve haematology; beware of contraindications!
<b>Xa-Inhibitors</b> Apixaban/ Edoxaban/ Rivaroxaban/	No evidence-based therapy Prothrombin complex concentrate (see under Phenprocoumon) as option	measure anti-Xa of Apixaban/ Rivaroxaban/Edoxaban before and after application
<b>IIa-Inhibitor</b> Dabigatran	No evidence-based therapy Idarucizumab (2x2.5 g) as specific antidot available	
<b>Antiplatelet</b>	No specific treatment (thrombocyte infusion potentially harmful)	

Note: NO efficacy in studies: steroids, tranexamic acid, activated Factor VIIa.

# Diagnostic algorithm for ICH

- 1) **Primary imaging in ED with CT or MRI** always with **angiography** – suspicion for macrovascular bleeding cause (AVM, aneurysm, bleeding in SVT, etc.)?
- 2) **Indication for invasive Angio (IADSA)**: interdisciplinary decision neuroradiology, neurosurgery, neurology, structured decision pathway is helpful (see below)
- 3) **SVD – Small vessel disease**: signs of microangiopathy in CT/MRI (leucencephalopathy, microbleeds)
- 4) **Follow-up imaging after 24h for evaluation of hematoma expansion** (prognostic marker and quality control)



Wilson et al, European Stroke Journal 2017

## Re-initiation of anticoagulatory medication after ICH

- **Heparin for prevention of thrombosis**: LMWH (e.g. Enoxaparin) after follow up imaging after 24h or pneumatic compression stockings
- **Antiplatelet monotherapy** ASS/Clopidogrel: depending on individual risk after follow up imaging earliest 7d after ICH
- **Phenprocoumon for mechanical heart valve**: earliest 7d after ICH in case of high embolic risk, otherwise 14d
- **(D)OAC for atrial fibrillation**: individual decision, consider atrial appendage closure

## Longterm prophylaxis

Treatment of blood pressure (aiml <140mmHg systolic), outpatient follow-up after 3 months

# Microbleeds

- differential diagnosis of incidental „microbleeds“ findings in SWI: thrombus, metastasis, microangiopathy, vasculitis, cerebral amyloid angiopathy, rub off metallic waves
- most frequent origin: microangiopathy
- consider always cerebral amyloid angiopathy (s. below)

## Microbleeds & Antiplatelet therapy/(D)OAC

- Effect of secondary prophylaxis with antiplatelet therapy and (D)OAC outweighs bleeding risk
- Bleeding risk and risk for ischemia rises with number of microbleeds, but risk for ischemia remains higher

# Cerebral amyloid angiopathy (CAA)

- Progressive dementia
- Frequently one or multiple small ischemic strokes or microbleeds in follow up images

## MRI: modified Boston criteria for age >55 y

### Possible CAA

- Singular bleeding lobar, cortical or cortical-subcortical localisation (cerebellar allowed)
- or focal or disseminated superficial siderosis
- exclusion of other causes of ICB

### Probable CAA

- multiple bleedings lobar, cortical or cortical-subcortical localisation (cerebellar allowed)
- or singular, cortical-subcortical bleeding and focal or disseminated superficial siderosis
- exclusion of other causes of ICB

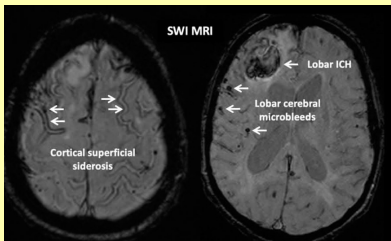
### Definitive CAA

- Autoptic proven

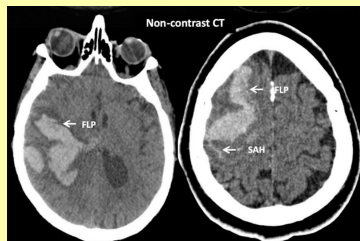
## CT: Edinburgh criteria

Finger-like projections (FLP): elongated extension from the hematoma (longer than wider)

Subarachnoid hemorrhage (SAH): extension of the bleeding in subarachnoid space



Hostettler, Seiffge & Werring, Expert Rev Neuroth 2019



## Amyloid angiopathy & Antiplatelet therapy/(D)OAC

- with probable CAA: stop antiplatelet therapy/(D)OAC
- consider atrial appendage closure in case of atrial fibrillation
- in case of mechanical waves individual decision (reports of low embolic risk without OAC in some types of waves)

# CAA-related Inflammation (CAA-ri)

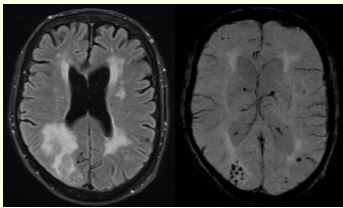
## Diagnostic criteria

### Possible CAA-ri (if all 5 criteria are met)

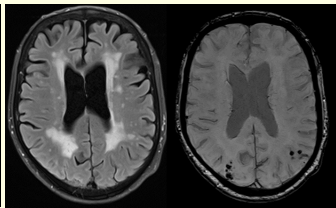
1. Age  $\geq$  40 years
2. Presence of at least one clinical symptom not directly associated with ICH, consisting of headache, impaired consciousness, behavioural abnormalities, focal neurological symptoms, epileptic seizures
3. MRI showing evidence of hyperintensities in the medullary canal extending to the surrounding subcortical medullary canal
4. Presence of at least one of the following corticosubcortical haemorrhages: cerebral macrohaemorrhage, cerebral microhaemorrhage, cortical superficial siderosis
5. Exclusion of neoplasia, infection, or other genesis.

### Likely CAA-ri

1. Age  $\geq$  40 Jahre
2. Presence of at least one clinical symptom not directly associated with ICH, consisting of headache, impaired consciousness, behavioural abnormalities, focal neurological symptoms, epileptic seizures
3. MRI demonstrating unifocal or multifocal hyperintensities in the medullary (corticosubcortical or deep medullary) bed that are asymmetric and extend to the surrounding subcortical medullary bed (and the asymmetry is not a result of old ICH)
4. Presence of at least one of the following corticosubcortical haemorrhages: cerebral macrohaemorrhage, cerebral microhaemorrhage, cortical superficial siderosis
5. Exclusion of neoplasia, infection, or other genesis



Right occipital asymmetric FLAIR hyperintensity + microbleeds



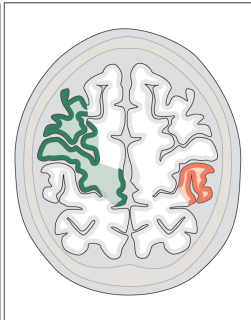
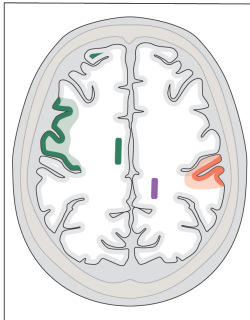
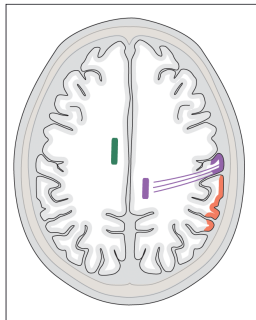
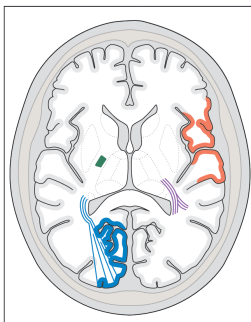
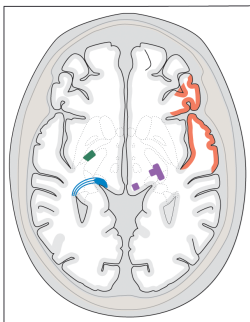
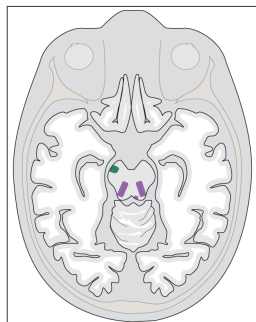
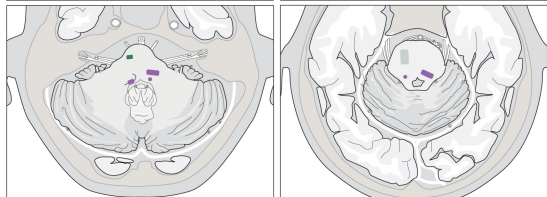
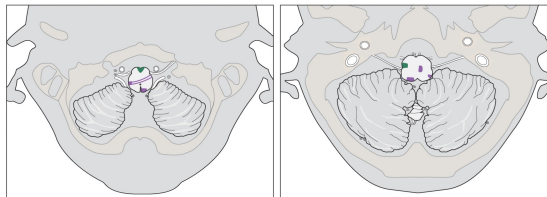
2 months after steroid therapy

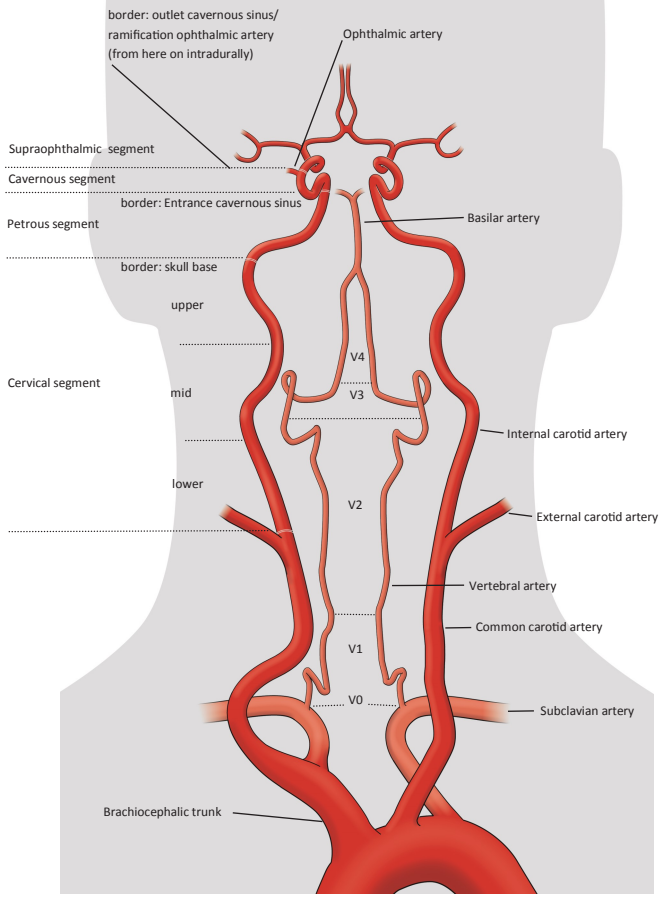
## Therapy

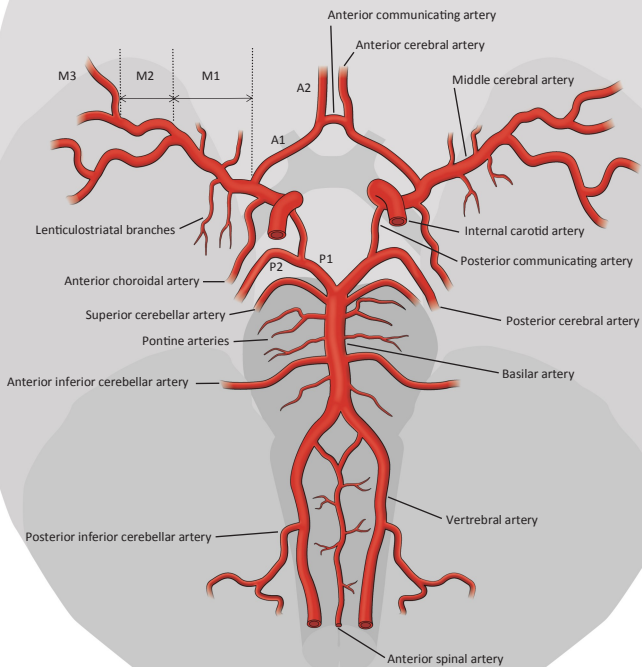
1. Steroid therapy
  - High-dose therapy with solumedrol 1g/d for 3d, followed by
  - Steroid maintenance therapy prednisolone 1mg/kg bw (under gastric and osteoporosis protection).
2. Additional immunosuppression, insufficient evidence as to which is preferable
  - Cyclophosphamide
  - Mycophenolate mofetil
  - Rituximab
3. Early control with ICH consultant after 4–6 weeks incl. MRI

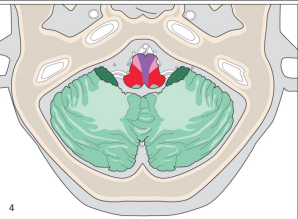
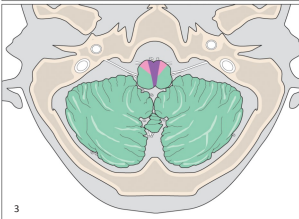
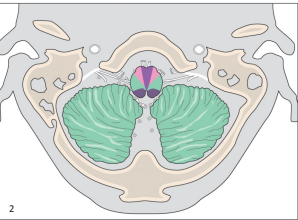
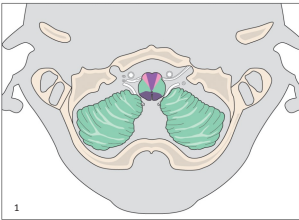
## Functional systems

- Motor areas
- Speech areas
- Visual areas
- Sensory areas

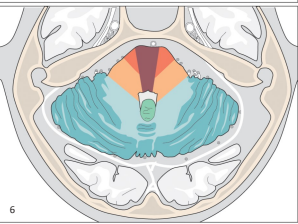
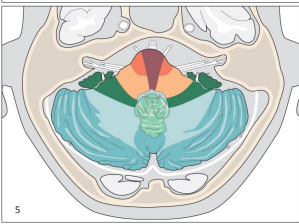




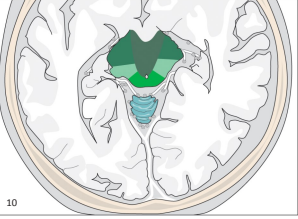
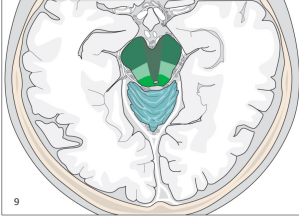
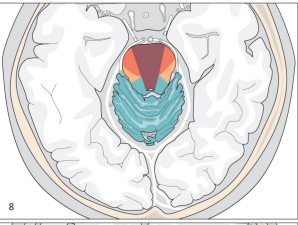
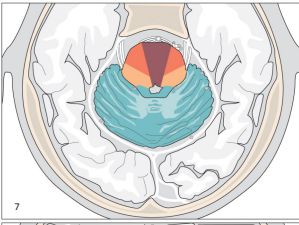




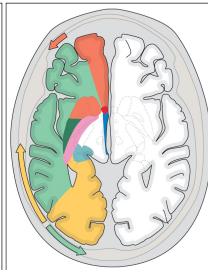
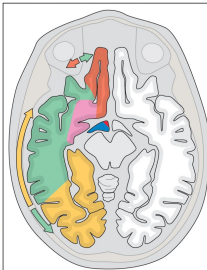
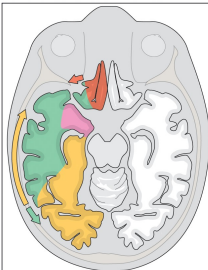
- Medulla oblongata (Fig. 1-4)**
- Anterior spinal artery
  - Anterior spinal artery  
Vertebral artery  
Posterior inferior cerebellar a.
  - Posterior spinal artery
  - Vertebral artery
  - Anterior inferior cerebellar a.
  - Posterior inferior cerebellar a.



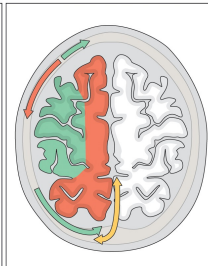
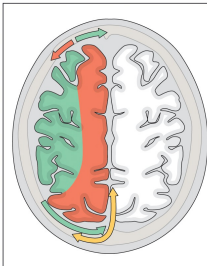
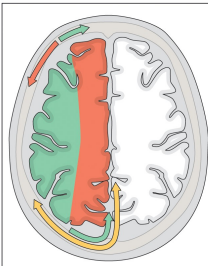
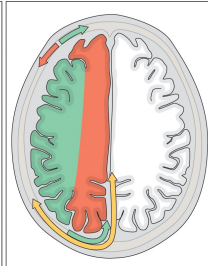
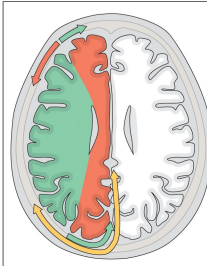
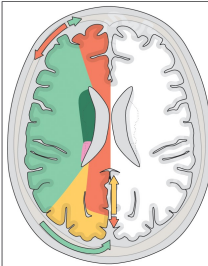
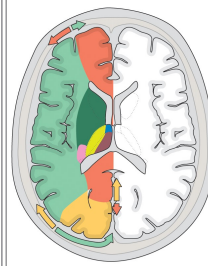
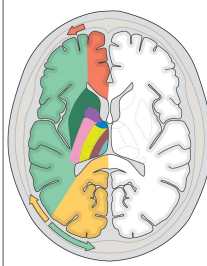
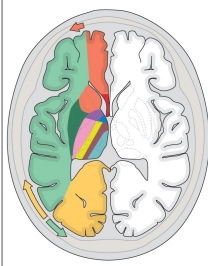
- Pons (Fig. 5-8)**
- Medial pontine a. of basilar a.; branches of posterior cerebral artery
  - Lateral pontine a. of basilar a.
  - Lateral pontine a. of basilaris a.  
Anterior inferior cerebellar a. (Fig. 8: Superior cerebellar a.)
  - Anterior inferior cerebellar a.
  - Posterior inferior cerebellar a.
  - Superior cerebellar a.



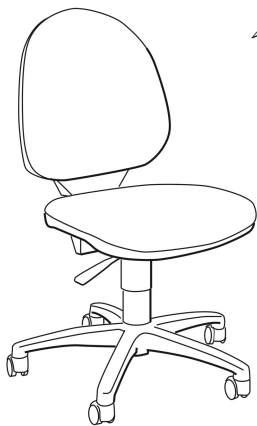
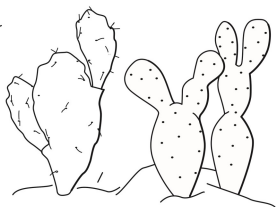
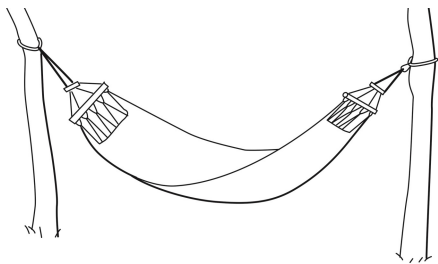
- Mesencephalon (Fig. 9-10)**
- Central posteromedial a. of posterior cerebral artery
  - Collicular and choroidal posterior medial a. of posterior cerebral artery
  - Collicular and choroidal posterior medial a. of posterior cerebral a.
  - Collicular and choroidal posterior medial a. of posterior cerebral a., superior cerebellar a.
  - Superior cerebellar artery



- Anterior cerebral a.
- Middle cerebral a.
- Middle cerebral a., lenticulostriate branches
- Posterior cerebral a.
- Anterior choroidal a.
- Posterior choroidal a. (from P2)
- Anterior communicating artery
- Posterior communicating artery
- Thalamoperforating A. (from P1 or BA; if jointly main trunk: Percheron artery)
- Thalamogeniculata a. (from P2)
- Internal carotid a.







**Close your eyes**

**He's a chip off the old block.**

**Harm set, harm get.**

**HUCKLEBERRY**

**BASEBALL PLAYER**

<b>Eye opening response</b>	4 Spontaneously 3 To speech 2 To pain 1 No response
<b>Best verbal response</b>	5 Oriented to time, place, and person 4 Confused 3 Inappropriate words 2 Incomprehensible sounds 1 No response
<b>Best motor response</b>	6 Obeys commands 5 Moves to localized pain 4 Flexion withdrawal from pain 3 Abnormal flexion (decorticate) 2 Abnormal extension (decerebrate) 1 No response

## CHA<sub>2</sub>DS<sub>2</sub>-VASc-Score (stroke risk with atrial f.)

Risk factor	Points	(N) O A C  I F  >1 P O I N T	Sum	Risk/year taking Aspirin
Congestive heart failure	1		0	0%
Hypertension	1		2	2.2%
Age > 75	2		3	3.2%
Diabetes mellitus	1		4	4.8%
Stroke/TIA/thromboembolism	2		5	7.2%
Vascular disease (heart, peripheral)	1		6	9.2%
Age 65-74 years	1		7	11.2%
Woman	1		9	12.2%

## Modified Rankin Scale (mRS)

<b>0</b>	No symptoms at all
<b>1</b>	No significant disability despite symptoms; able to carry out all usual duties and activities
<b>2</b>	Slight disability; unable to carry out all previous activities, but able to look after own affairs
<b>3</b>	Moderate disability, requiring some help, but able to walk without assistance
<b>4</b>	Moderately severe disability; unable to walk without assistance and unable to attend own bodily needs
<b>5</b>	Severe disability; bedridden, incontinent and requiring constant nursing care and attention
<b>6</b>	Dead

# NIH Stroke Scale

Points	Category	Explanation
	<b>Level of consciousness</b>	0 Alert 1 Not alert, but arousable by minor stimulation 2 Not alert, requires repeated stimulation to attend. Or, obtunded and requires painful stimuli to make movements 3 Makes only reflexive posturing movements to repeated painful stimuli. Or, they are totally unresponsive
	<b>Orientation</b> anarthria, intubation=1, coma=2	Ask the current month and the patient's age. 0 Answered both questions correctly 1 Answered one correctly 2 Answered neither question correctly or aphasia
	<b>Commands</b>	Ask the patient to open/close the eyes and make a fist/relax the non-paretic hand. 0 Performed both correctly 1 Performed one correctly 2 Performed neither correctly
	<b>Best gaze</b> uncooperative=1, coma=2	0 Normal 1 Partial gaze palsy = Conjugate gaze deviation that can be overcome with voluntary or reflexive activity 2 Forced deviation
	<b>Visual Fields</b> not evaluable=0, neglect=1, coma=3, in case of aphasia, evaluate reaction	0 No visual loss 1 Partial hemianopia 2 Complete hemianopia 3 Bilateral hemianopia
	<b>Facial palsy</b> coma=3	0 Normal 1 Minor paralysis (flattened nasolabial fold or mild asymmetry while smiling) 2 Partial paralysis (total or near total paralysis of lower face) 3 Complete paralysis of upper and lower face
Left:	<b>Motor arm</b> coma=4	0 No drift, remains in position for 10 sec. after an initial dip 1 Jerks or drifts to an intermediate position without encountering support before the full 10 sec. 2 Some effort against gravity. Drifts down before 10 sec. 3 No effort against gravity and the arm falls 4 No voluntary movement
Right:		
Left:	<b>Motor leg</b> coma=4	0 No drift, remains in position for 5 sec. after an initial dip 1 Jerks or drifts to an intermediate position without encountering support before the full 5 sec. 2 Some effort against gravity. Drifts down before 5 sec. 3 No effort against gravity and the leg falls 4 No voluntary movement
Right:		

Points	Category	Explanation
	<b>Limb ataxia</b> coma, aphasia, paralyzed=0	0 Absent 1 Present in one limb 2 Present in two limbs
	<b>Sensory</b> bilateral loss=2, coma=2 aphasia=rather 1	0 Normal 1 Mild to moderate sensory loss, patient feels asymmetry between the two sides but is still aware of being touched 2 Severe or total sensory loss, patient is not aware of being touched on the face, arm, and leg
	<b>Best language</b> Intubated patients should be asked to write, coma=3	0 No aphasia 1 Mild to moderate aphasia; some obvious loss of fluency or facility of comprehension without significant limitation on ideas expressed or form of expression 2 Severe aphasia; all communication is fragmentary; great need for inference, questioning, and guessing by the examiner 3 Mute or global aphasia; globally aphasic patients have no usable speech or auditory comprehension
	<b>Dysarthria</b> coma=2	0 Normal 1 Mild to moderate dysarthria; patient can still be understood 2 Severe dysarthria; patients are either mute or speech is so slurred they cannot be understood out of proportion to any dysphasia that is present
	<b>Extinction and inattention</b> coma=2	0 Absence of neglect 1 Inattention to one modality only (visual, tactile, auditory, spatial, or personal inattention) 2 Profound hemi-inattention or extinction to more than one modality; does not recognize own hand or orients only to one side of space



0.05



0.1



0.2



0.25



0.32



0.4



0.5



0.63



0.8



1.0

Distance: 40cm

Visus