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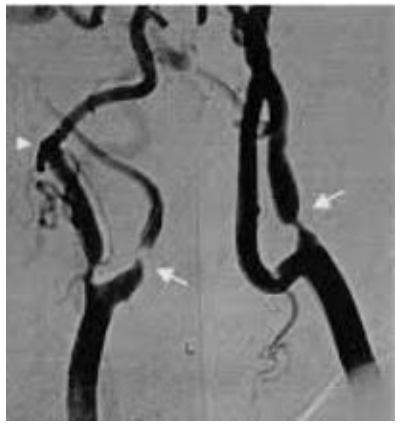
Cerebral hyperperfusion syndrome

(CHS)

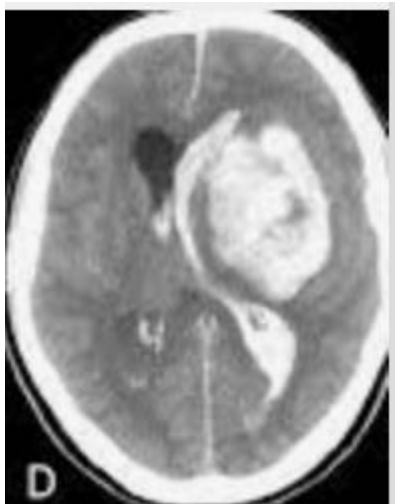


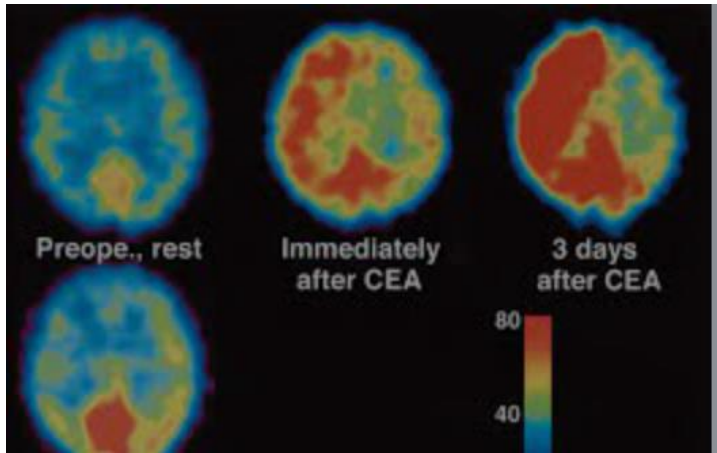
Guy Raphaeli, M.D.

Director of stroke unit

Interventional Neuroradiologist

Petach-Tikva, Israel





Illustrative case

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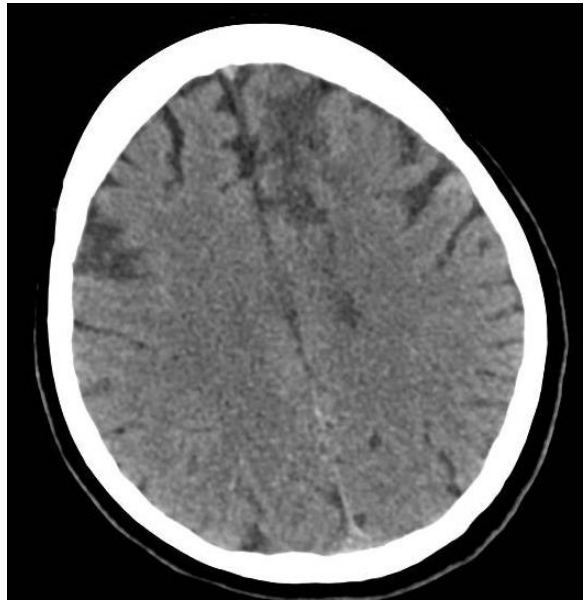
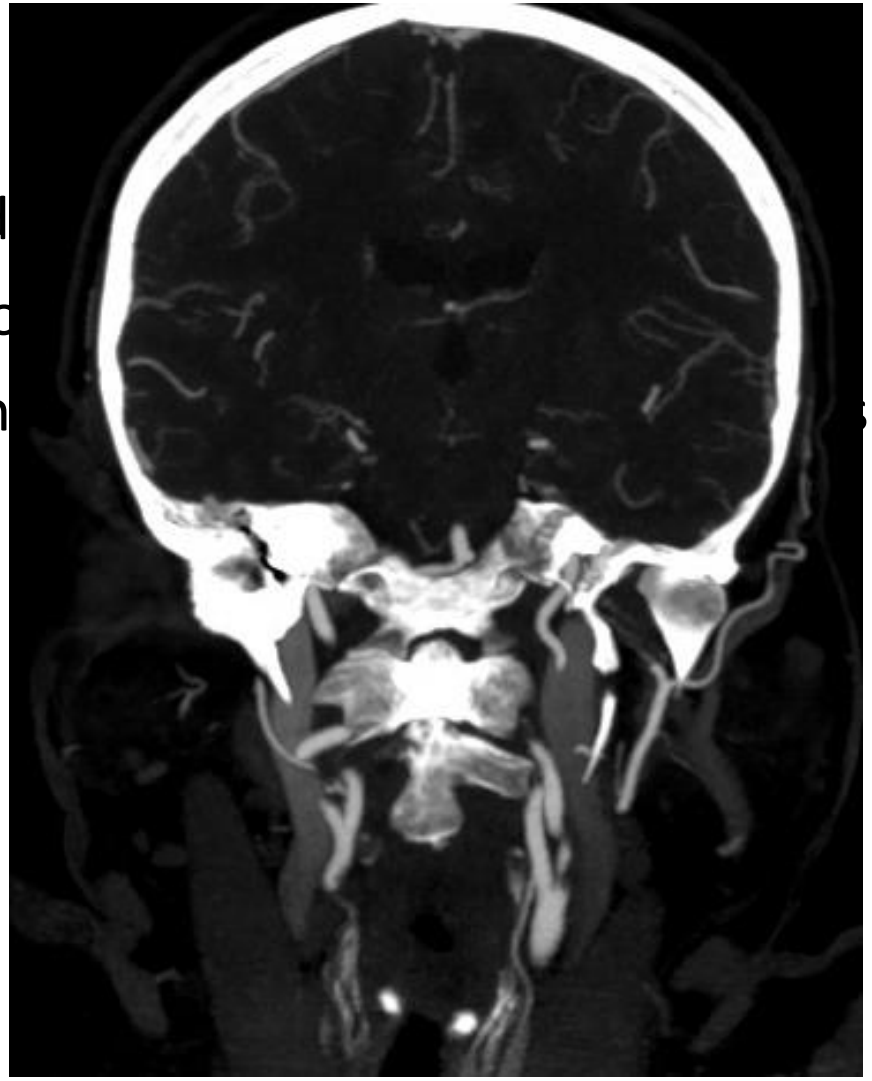
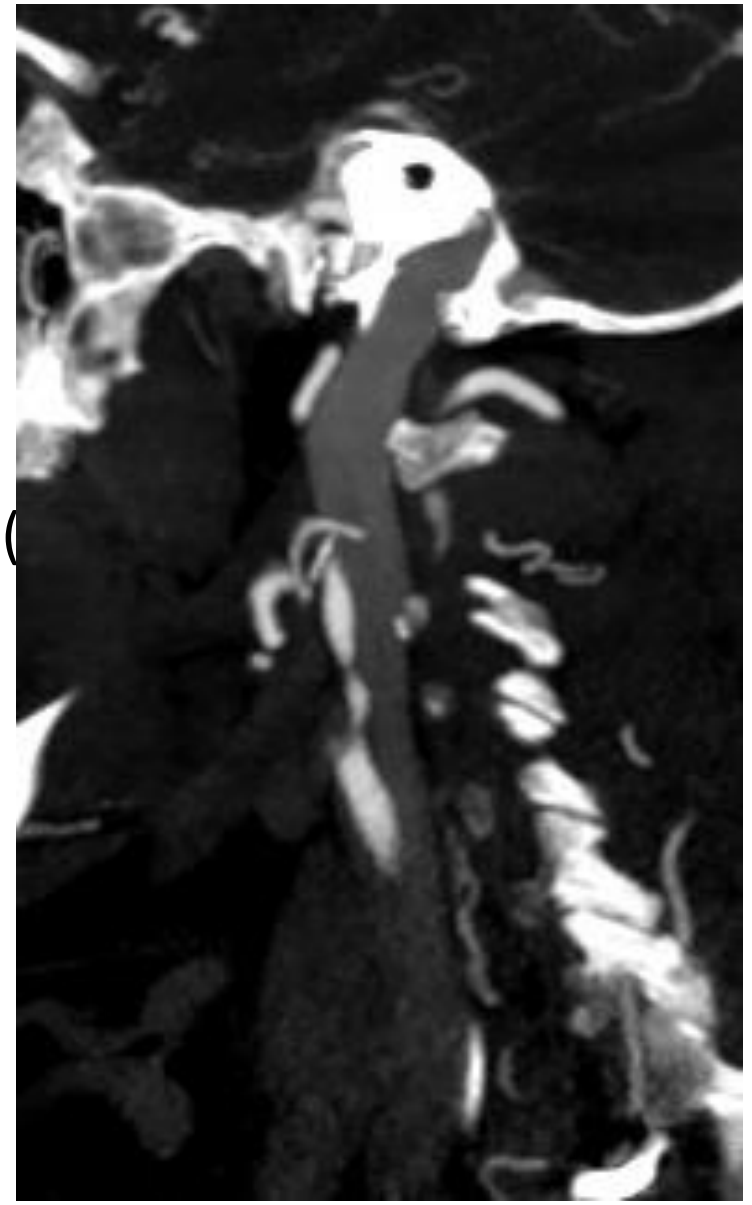
- 64/F
- Medical Hx: HTN, dyslipid
- 1 month prior to admissio
- Neurological examination







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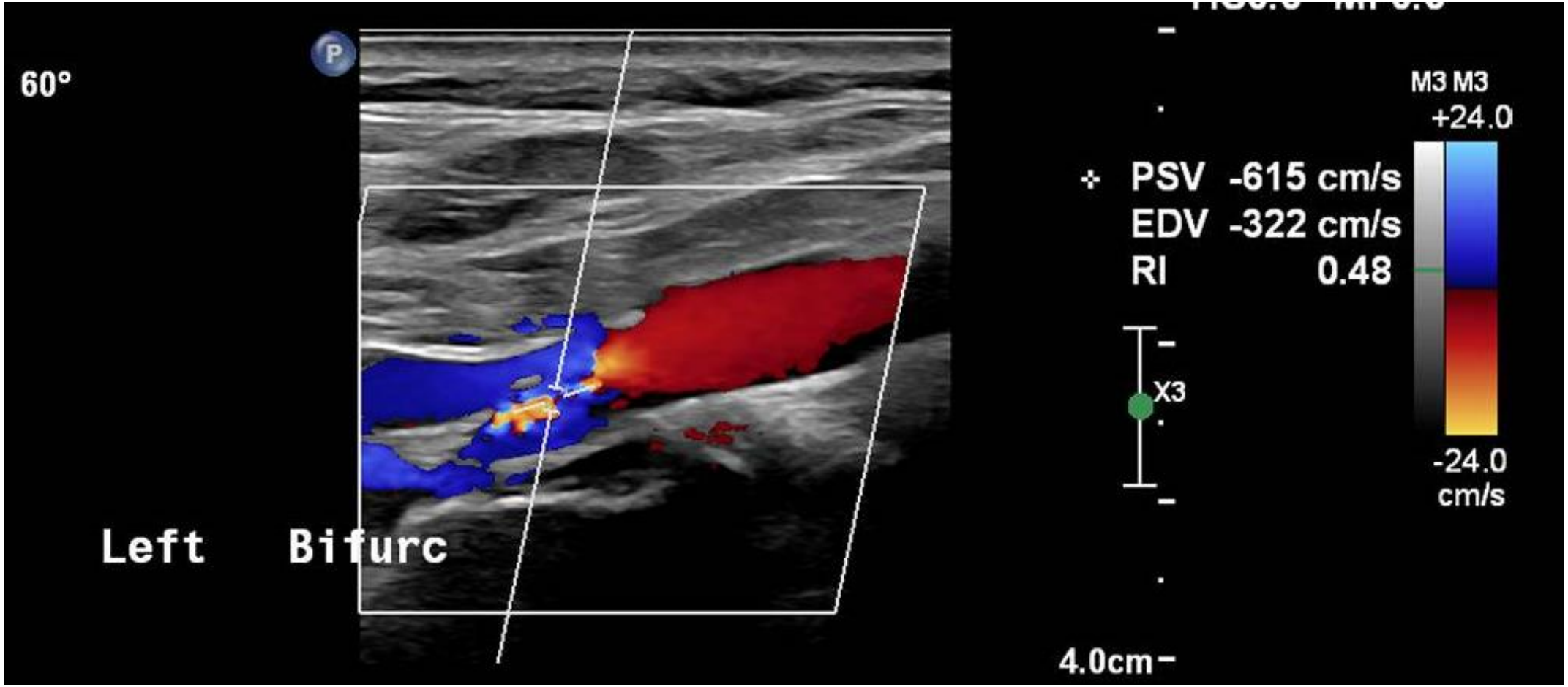
Doppler



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Was diagnosed & hospitalized with Symptomatic LICA stenosis.

Aspirin, Plavix, high dose statins ; Clexane Prophylaxis dosing

Doppler:

LICA – 95%-99% stenosis; RICA – WNL

Aphasia ; No change in CT

RT		LT		
Veiocity/EDV Peak Systolic Cm/Sec			End Diastola	
55	CCA	57		
164	ECA	121		
118	ICA BIF	615	322	
118	PROX - ICA	508	164	
106	ICA DISTAL	50		
113	VERTEBRAL	51		

CAS was proposed following stroke team recommendations

The patient developed excessive systolic BP on the day of intervention, prior to CAS

On the angio table, became agitated and incooperative

GA (propofol) with laryngeal mask

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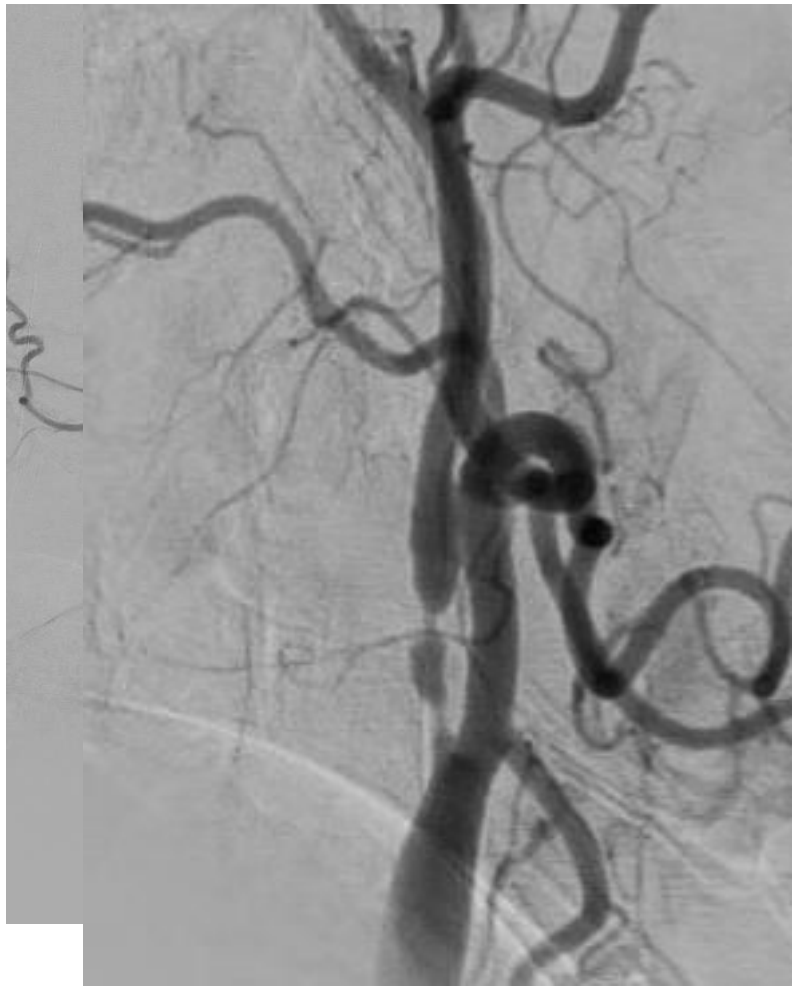
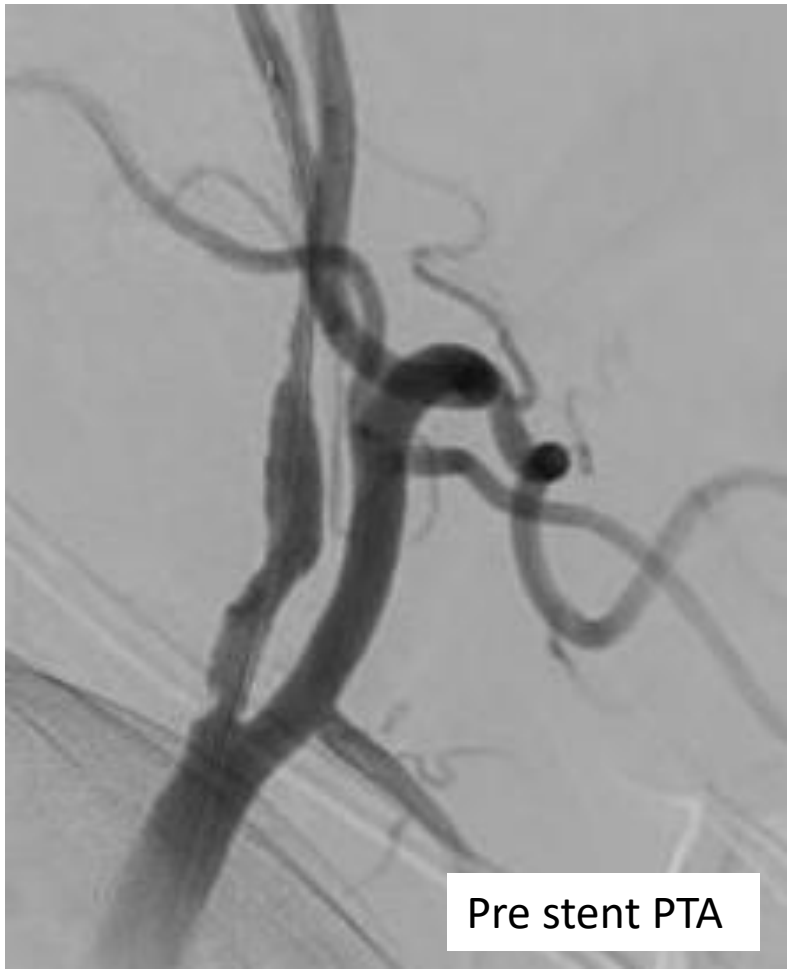
2/09/2021

In-op : mean BP around 120





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Post-op

	Post procedure	24hrs	48hrs
BP	120-130/60 Max 173/69 (10 hrs post)…	all night around 140/80…	Morning 148/73
Neurologic status	intact	intact	Recurrent Focal seizure RUL Rt. Moderate hemiparesis; No aphasia
Action	Normopressan 75 mg once	Vasodip (lercanidipine) 10mg once	CT Assival, Keppra, phenytoin

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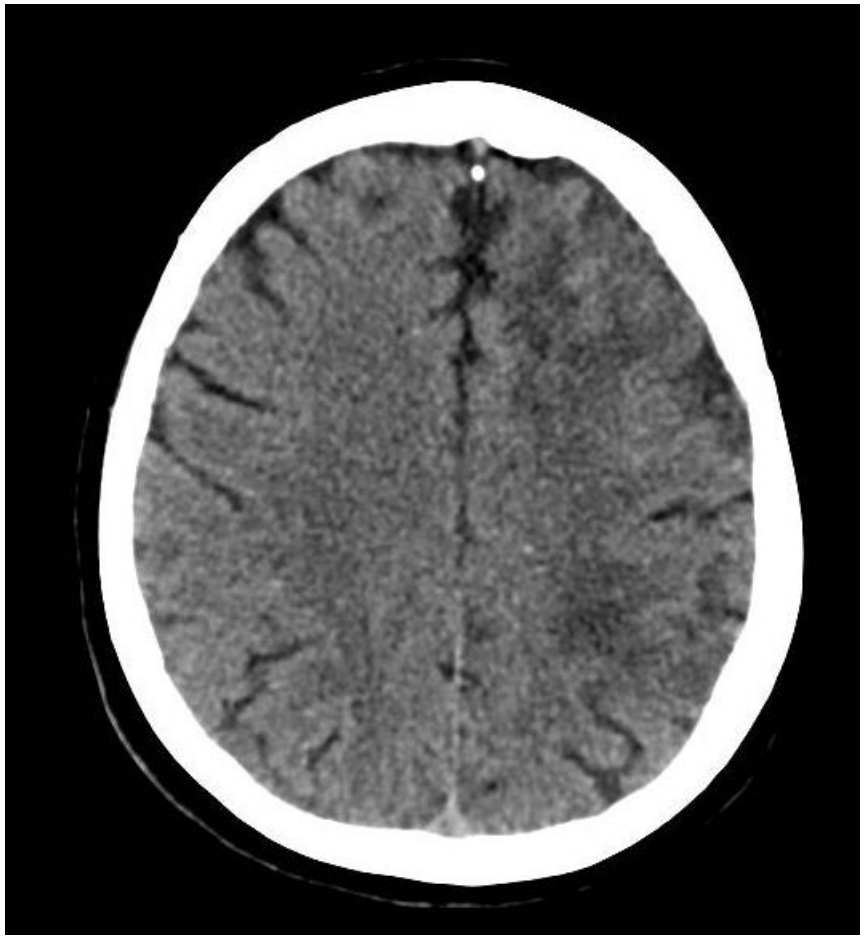
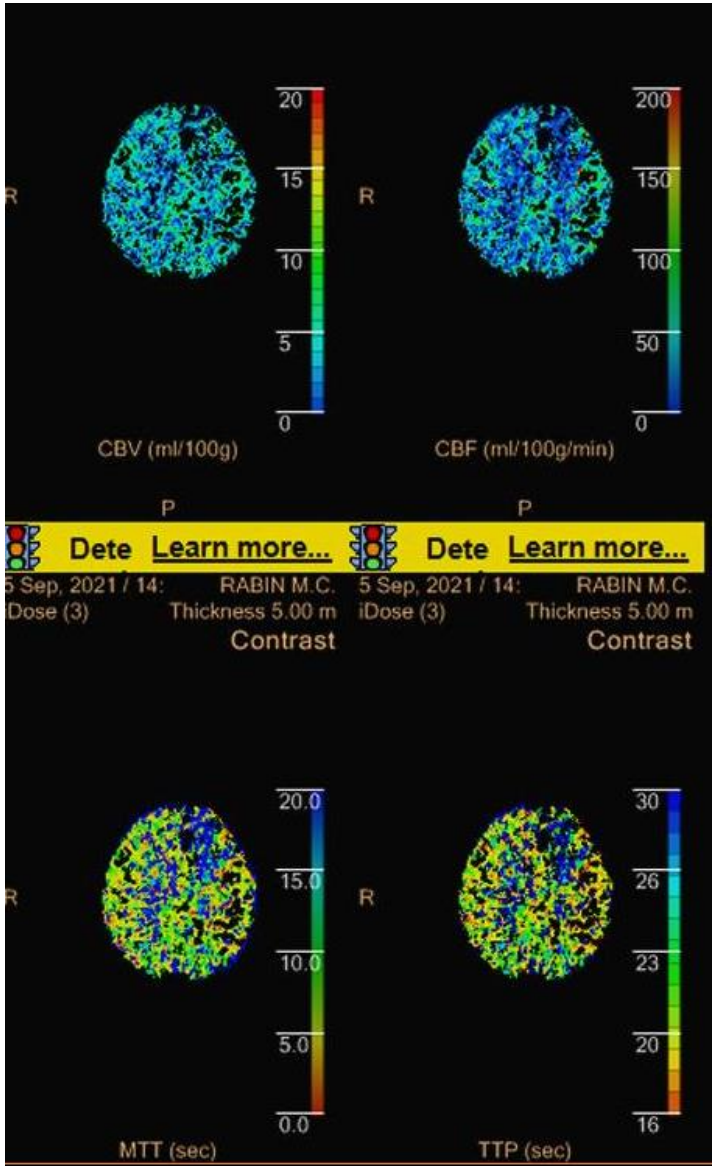
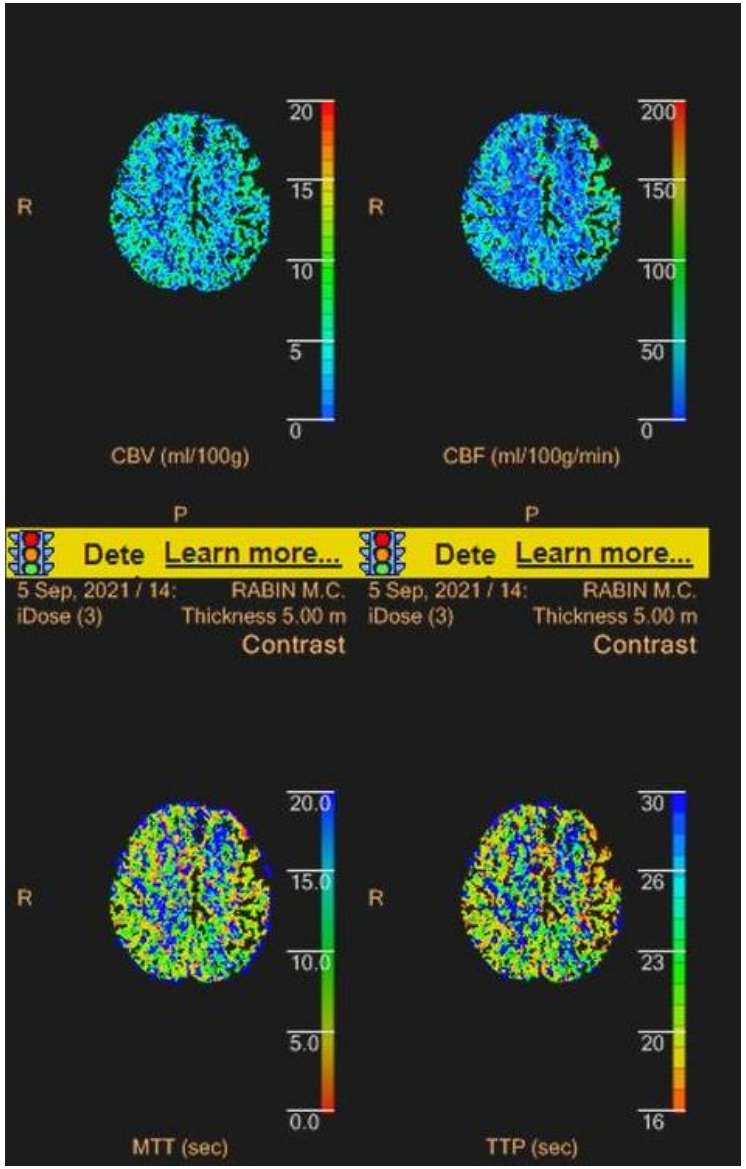
48 hrs post CAS…







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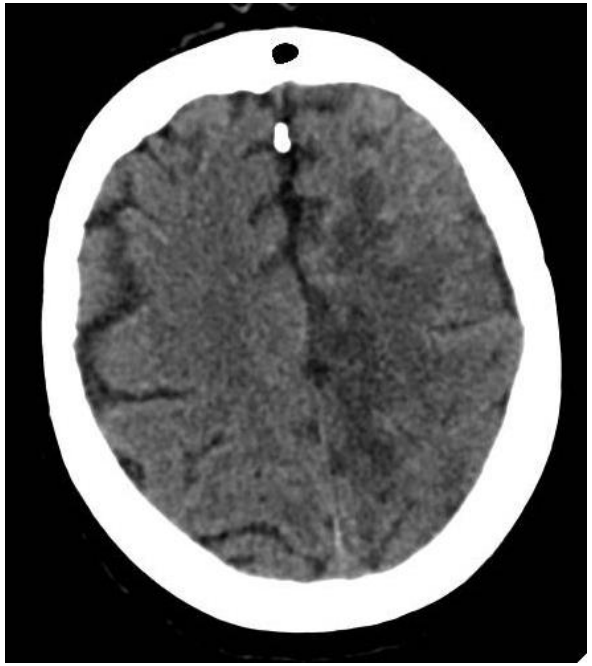
POD 3

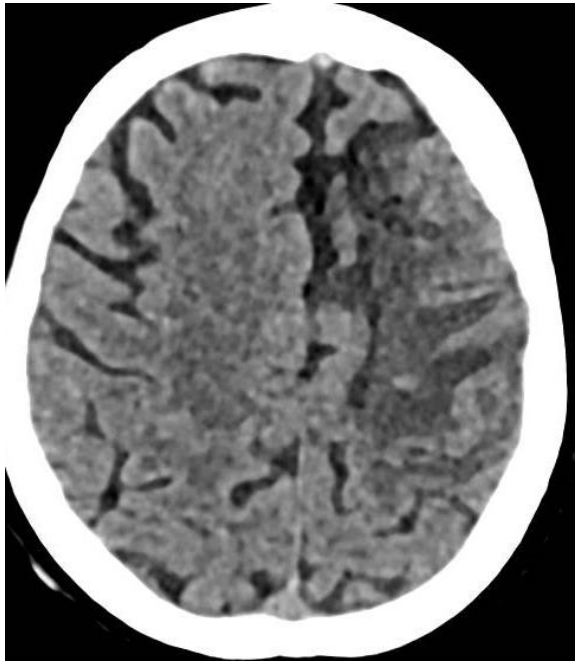
Mild dysphasia, Rt. Hemiplegia
BP – 140/68
Normopressan 150*3
BP – 168/75 - Labetolol drip ;
Transferred to ICU

POD 5



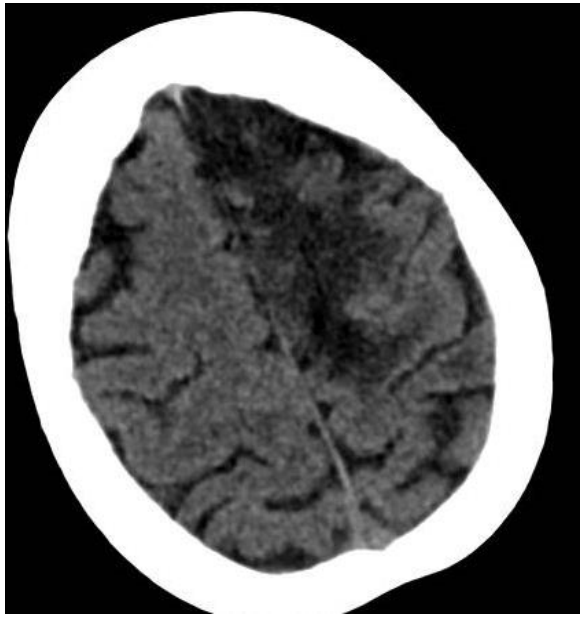
Contineous focal fits ;
multiple AED
Frizium initiated

POD 10



EEG – Continuous PEDs
left fronto-temporo-centra
Day 10 vimpat initiated
Day 12 Fycompa initiated

POD 45



Severe mixed dysphasia
Rt. Flaccid hemiplegia
NIHSS 14
Deceased d/t pneumonia

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Summary

Hyper-perfusion syndrome post CAS

Red flags:

Uncontrolled HTN

Severe stenosis (sub-occlusive; distal arterial collapse)

Timing (day 30 since onset)

REVIEW

Update on cerebral hyperperfusion syndrome

Yen-Heng Lin ,[1] Hon-Man Liu[2,3]

135 articles reviewed
56 articles included

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Cerebral hyperperfusion syndrome (CHS)

Incidence

- 4446 patients
- CHS is a rare but severe complication
- Most common – following CEA; was documented post stenting for ICAD and post MT for AIS
- CHS incidence: 1.16% (up to 4.6%; 8731 pts)
- Incidence variability due to :
    - different patient profile CAS Vs. CEA
    - CAS pts are treated by DAP and AC peri-procedural
- ICH incidence: 0.74%

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Cerebral hyperperfusion syndrome (CHS)

Clinical presentation

Severe headache (ipsilateral or diffuse), eye and facial pain
Focal neurological deficits
Seizures
ICH or SAH
Loss of consciousness

Timing :

12 hours after CAS, and 6 days after CEA

Hemorrhage - CAS (1.7±2.1 days); CEA (10.7±9.9 days)

Up to 1 month after the procedure

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Cerebral hyperperfusion syndrome (CHS)

Risk Factors

Stenosis ≥90%

Severe contralateral disease (≥80%)

Longstanding pre-existing hypertension

With all three conditions: **16%** !

.

Other risk factors:

Female

chronic kidney disease

left-sided carotid disease

progressive neurological deficit

recurrent hemorrhage

pre-existing brain lesions

microvascular disease (SVD)

JACC 2004

Cerebral hyperperfusion syndrome (CHS)

Imaging

TCD

- X1.5-2 increase in MCA mean systolic velocity in CHS – good correlation to CBF
- As there is no change in MCA diameter by cerebral autoregulation, MCA flow variation is well noticed
- BP normalization and MCA flow velocities – in correlation with clinical improvement

Prospective study
558 pts
21 (3.8%) pts - CHS

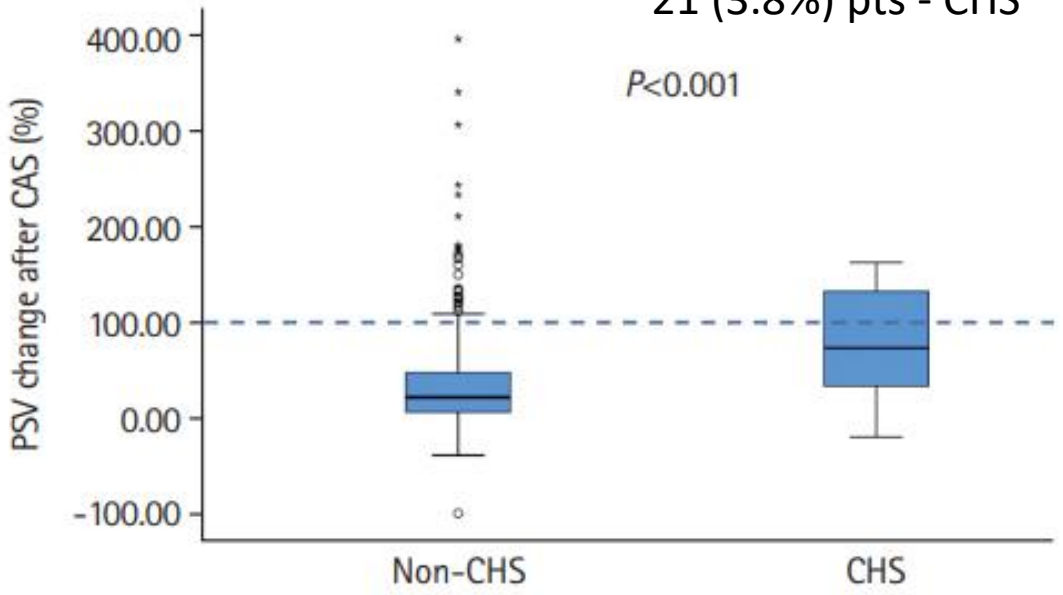

Figure 1. Comparison of peak systolic velocity (PSV) changes after carotid artery stenting (CAS) between the non-cerebral hyperperfusion syndrome (CHS) and CHS groups.

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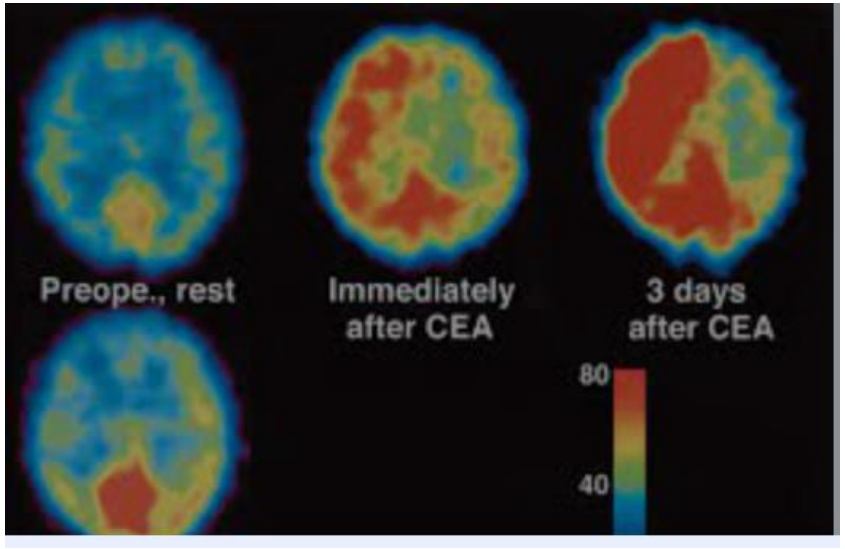
Cerebral hyperperfusion syndrome (CHS)

Imaging

Cerebral perfusion imaging

CT perfusion - different criteria : ↑ CBF + CBV ; ↓ MTT+TTP
Perfusion weighted imaging MRI
SPECT – 100% increase in uptake (no baseline data)



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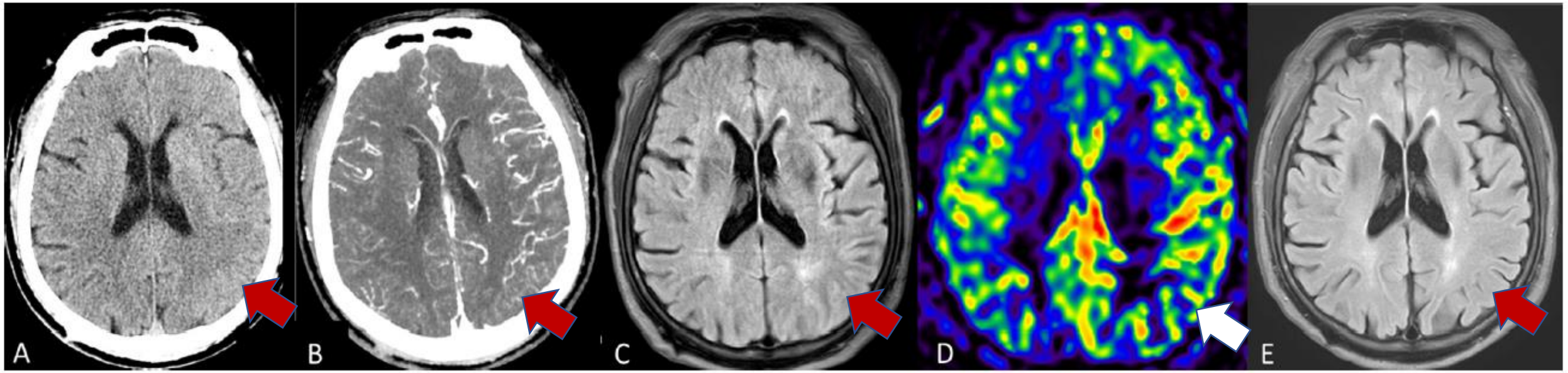
Cerebral hyperperfusion syndrome (CHS)

Radiological findings



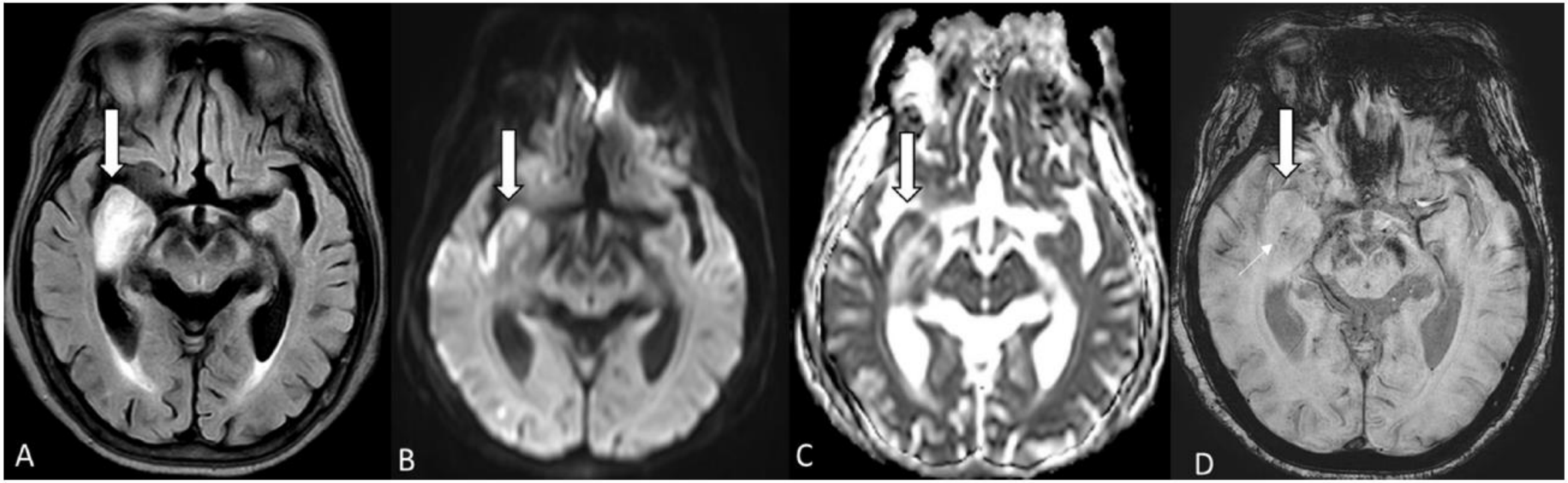
Patchy or diffuse white matter edema involving the posterior parieto-occipital lobe	Focal hyperemia	Swelling w/o ischemia	Increased CBF	Complete resolution

Negative radiological finding cannot exclude CHS

Cerebral hyperperfusion syndrome (CHS)

MRI

Post M1 MCA recanalization (AIS)



FLAIR DWI ADC SWI

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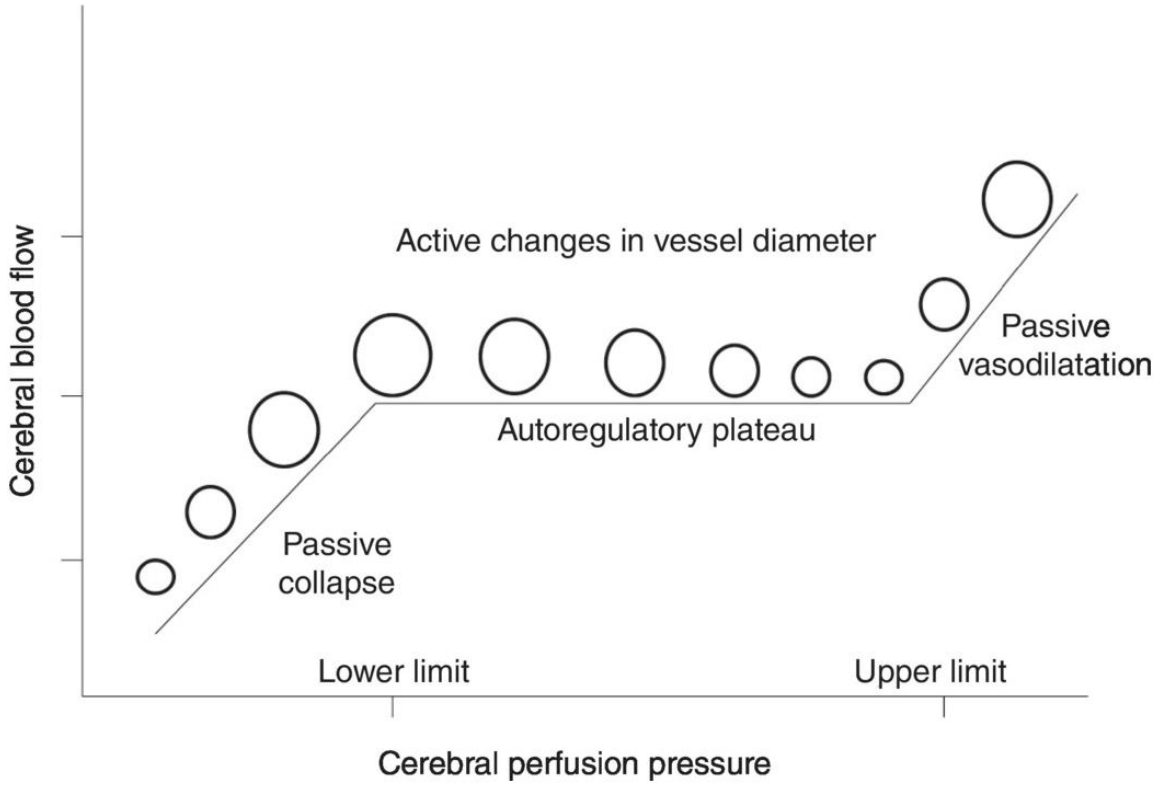
Cerebral hyperperfusion syndrome (CHS)

Pathophysiology

1. **Impairment of cerebral autoregulation**
   - The most accepted mechanism
   - Myogenic Vs. neurogenic component
2. Damage from free radicals
   - (vasodilatation, vessel wall permeability,
   - endothelial injury --- hyperperfusion..
   - Scavenger role ?)
3. Baroreceptor reflex breakdown
   - -carotid body stimulation ---
   - hemodynamic changes (PTA, stent, CEA)
4. Trigemino-vascular reflex
   - Neuropeptide discharge leads to vasoconstriction



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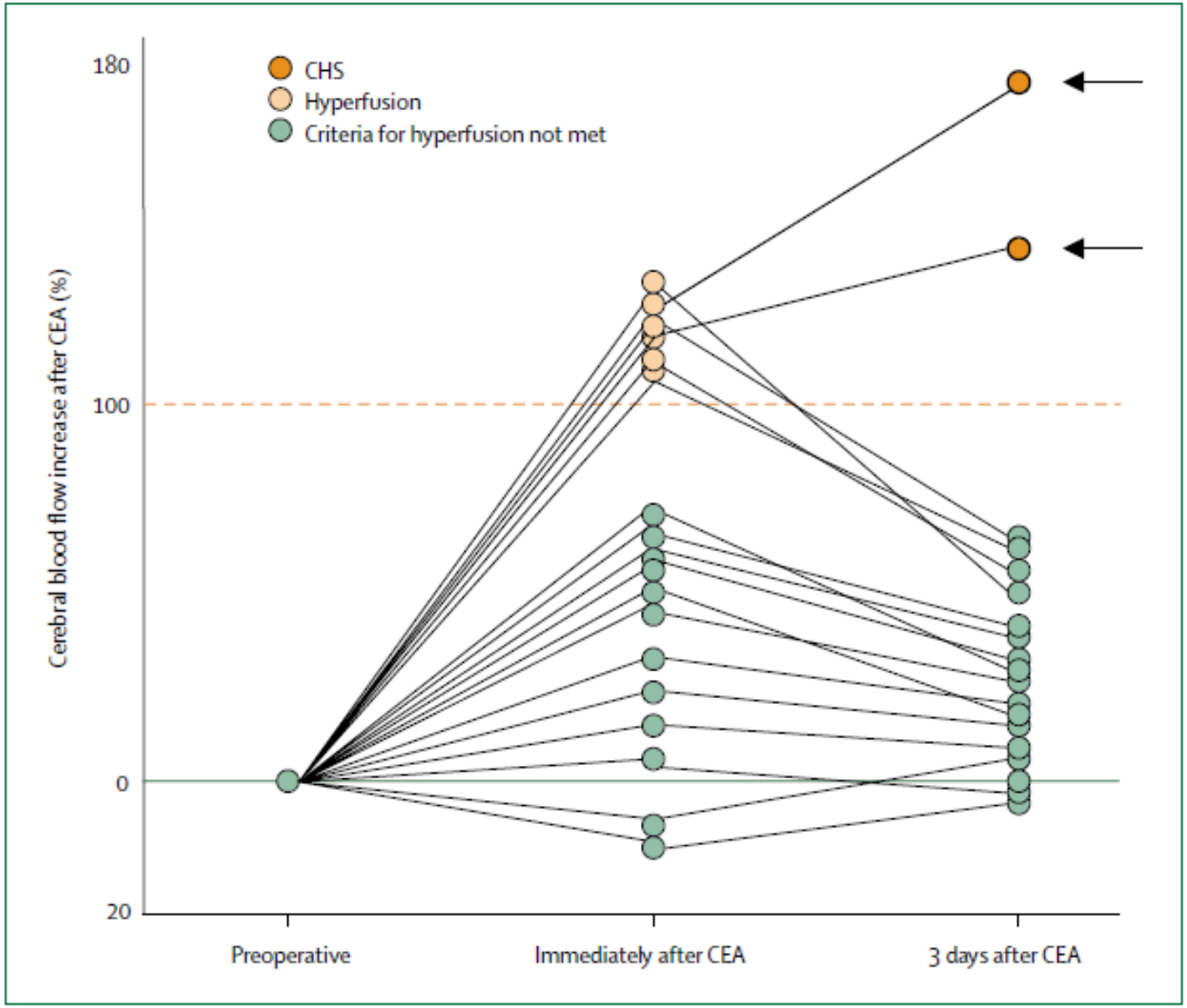
CHS - Pathophysiology

Impairment of cerebral autoregulation

↑ CBF MCA ---- ↑↑↑ CBF ---- CHS



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CHS - Preventive measures and management

Blood pressure :

Under 140/90 ; High risk patients – 120/80

BP protocol : pre CAS – Nitroglycerin

post CAS - Labetolol, metroprolol

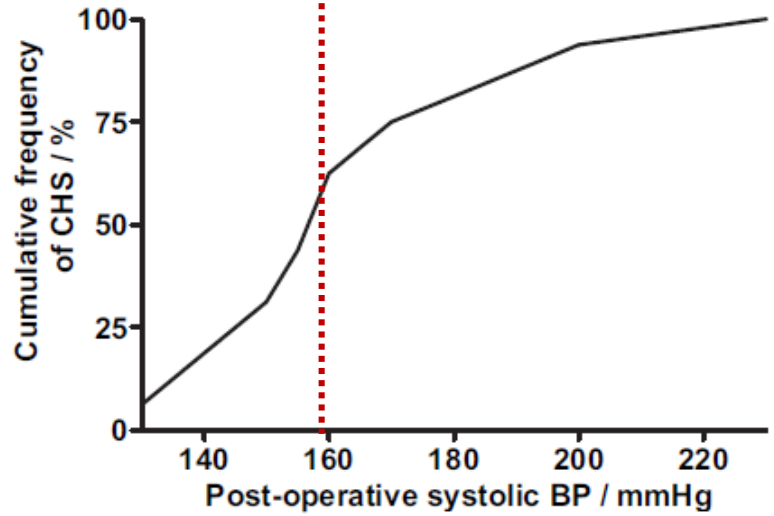
tight control back home after discharge

High risk pts for CHS :

HTN, >90% stenosis, poor collateral flow (≥ 80% contralat ICA)

BP monitoring – A-Line or NIBP each 15 min

(1) Within 30 days post-CEA;



Cerebral hyperperfusion syndrome

Staged angioplasty (SAP)

2007-2014
Japan
44 centers who performs SAP

Inclusions:

- Atherosclerotic carotid stenosis
- High risk patients (SPECT criteria)

Exclusions:

- Ipsilateral carotid occlusion who needed MT
- Angioplasty or regular CAS within 30 days of any ipsilateral ICH

Risk assessment modality

66% used quantitative SPECT with Diamox - ↓ 80% CBF

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Cerebral hyperperfusion syndrome

Staged angioplasty (SAP)

Stage 1 : angioplasty

using an undersized balloon

(diameter of approximately 3.0 mm)

under proximal protection (Balloon inflation CCA+ECA)

w/o distal protection

Stage 2: definitive CAS

2-4 weeks later

CHS criteria :

- immediate post procedure : headaches, seizures, reduced LOC, focal neurological signs
- No signs of cerebral ischemia
- Perfusion studies – SPECT or other; evidence of significant increase in ipsilateral CBF
- ICH

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Cerebral hyperperfusion syndrome
Staged angioplasty (SAP)
Periprocedural events

	"Scheduled" Group			"As Treated" Group		
Event	SAP (n = 113)	Regular CAS (n = 419)	p Value	SAP (n = 102)	Regular CAS (n = 428)	p Value
CHS	5 (4.4)	44 (10.5)	0.047	4 (3.9)	45 (10.5)	0.039
Ipsilat ICH	1 (0.9)	22 (5.3)	0.039	1 (1.0)	22 (5.1)	0.099
TIA or ischemic stroke	11 (9.7)	40 (9.5)	0.952	10 (9.8)	40 (9.3)	0.887
TIA	5 (4.4)	7/418 (1.7)	0.143	5 (4.9)	7/427 (1.6)	0.061
Ischemic stroke	6 (5.3)	34 (8.1)	0.316	5 (4.9)	34 (7.9)	0.290
Non-ipsilat ICH	0	2 (0.5)	1.000	0	2 (0.5)	1.000
Major bleeding	0	2 (0.5)	1.000	0	2 (0.5)	1.000
AMI	0	5 (1.2)	0.590	0	5 (1.2)	0.589
Death	1 (0.9)	3 (0.7)	1.000	0	3 (0.7)	1.000
MAE	7 (6.2)	54 (12.9)	0.048	6 (5.9)	54 (12.6)	0.054

SAP –- less favorable baseline factors – more severe stenosis (89% Vs. 85%)

- much poor SPECT results with more reduced CBF

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Staged angioplasty (SAP)

Factors related to CHS

Factor	"Scheduled" Group			"As Treated" Group		
	OR	95% CI	p Value	OR	95% CI	p Value
Age (per 1-yr increase)	1.000	0.959–1.042	0.994	1.000	0.960–1.043	0.991
Sex, female	1.306	0.573–2.977	0.525	1.309	0.574–2.985	0.522
Revascularization w/in 7 days of symptom onset	1.643	0.562–4.804	0.364	1.667	0.570–4.874	0.350
Angiographic stenosis (per 1% increase)	1.074	1.027–1.123	0.002	1.074	1.027–1.123	0.002
SAP	0.315	0.120–0.828	0.019	0.275	0.095–0.794	0.017

Conclusion

SAP may be an effective revascularization procedure to avoid CHS for patients with carotid stenosis at high risk for CHS, without increasing periprocedural cerebral ischemic complications

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Staged angioplasty (SAP) : study limitations

- No Standard protocol for anesthesia
- Protection method (proximal protection Vs. distal)
- Interval between submaximal angioplasty and stenting (2-4 weeks)
- Standards for evaluating CHS
- Ischemic stroke ? (no data about silent lesions by MRI)
- Selection bias (retrospective study)
- Multicenter - Not standardized (different stents, anti-aggregants, BP management\monitoring; SPECT application)

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Cerebral hyperperfusion syndrome (CHS)

Take home message

- Aggressive treatment for BP
- Aggressive treatment of focal SE

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Thank you …

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