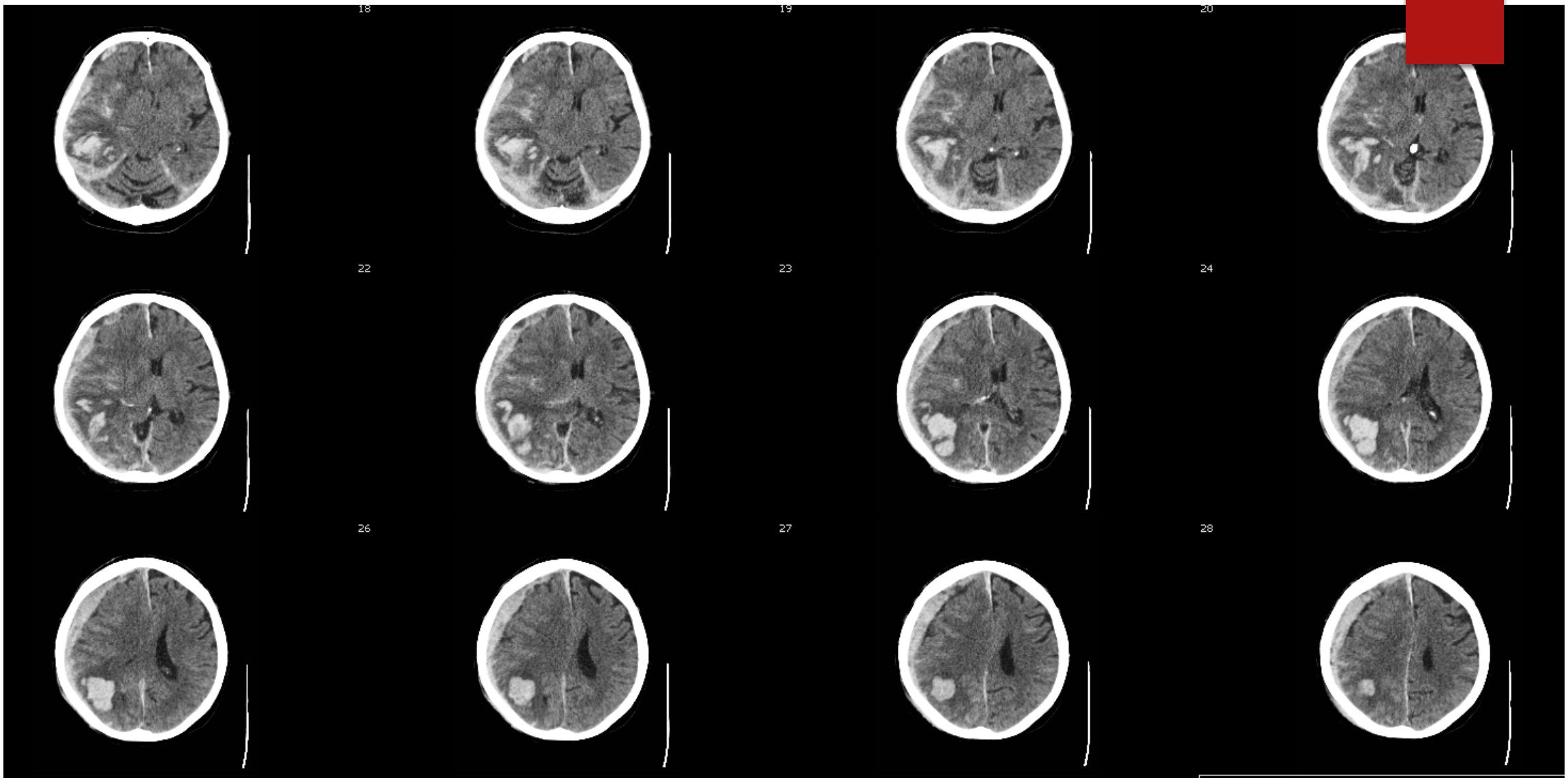
Z pohledu neurochirurga…

MUDR. ANDREJ MRLIAN, PH.D.

NEUROCHIRURGICKÁ KLINIKA FN BRNO, LF MU

FAKULTNÍ NEMOCNICE BRNO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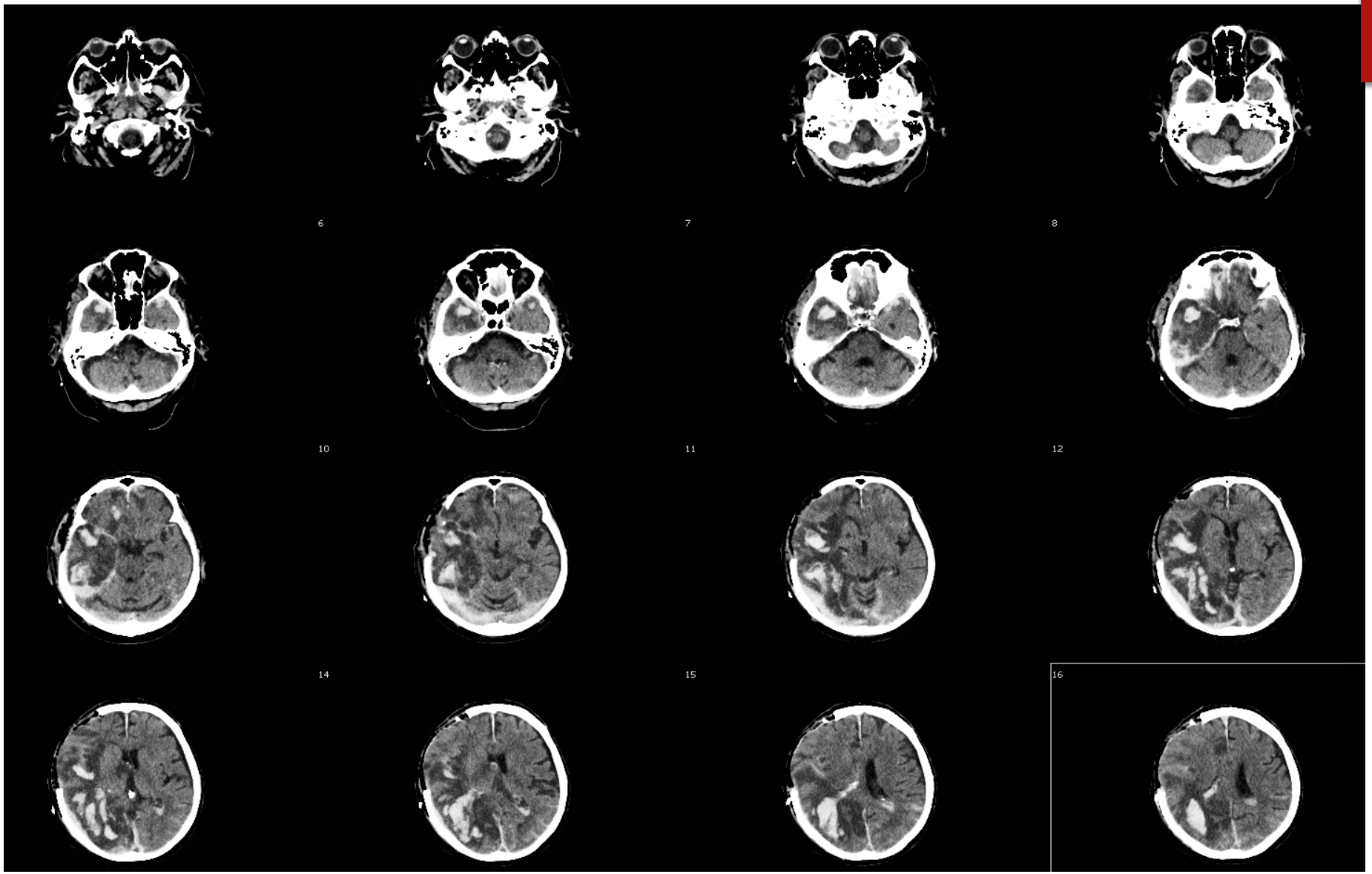
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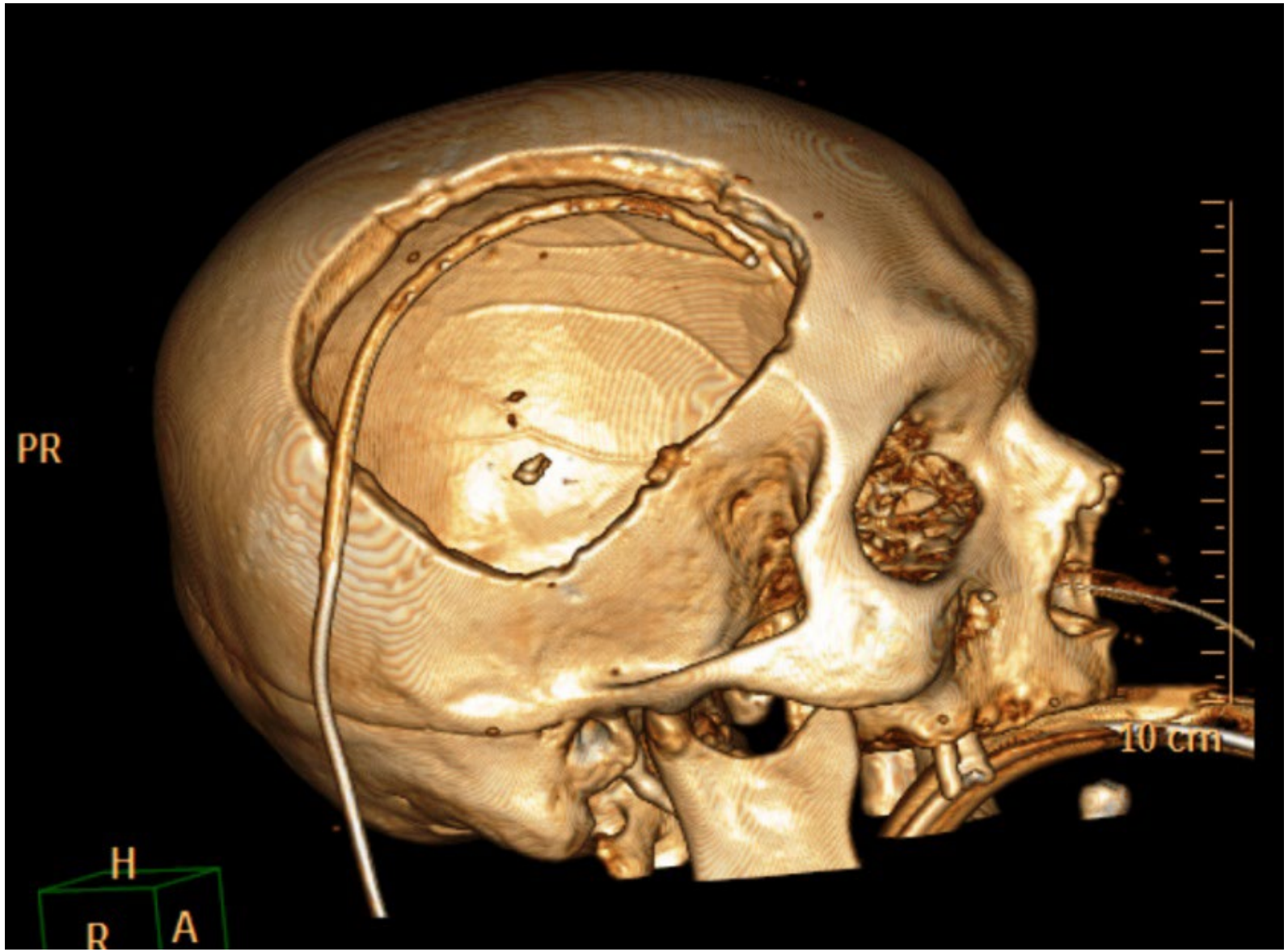
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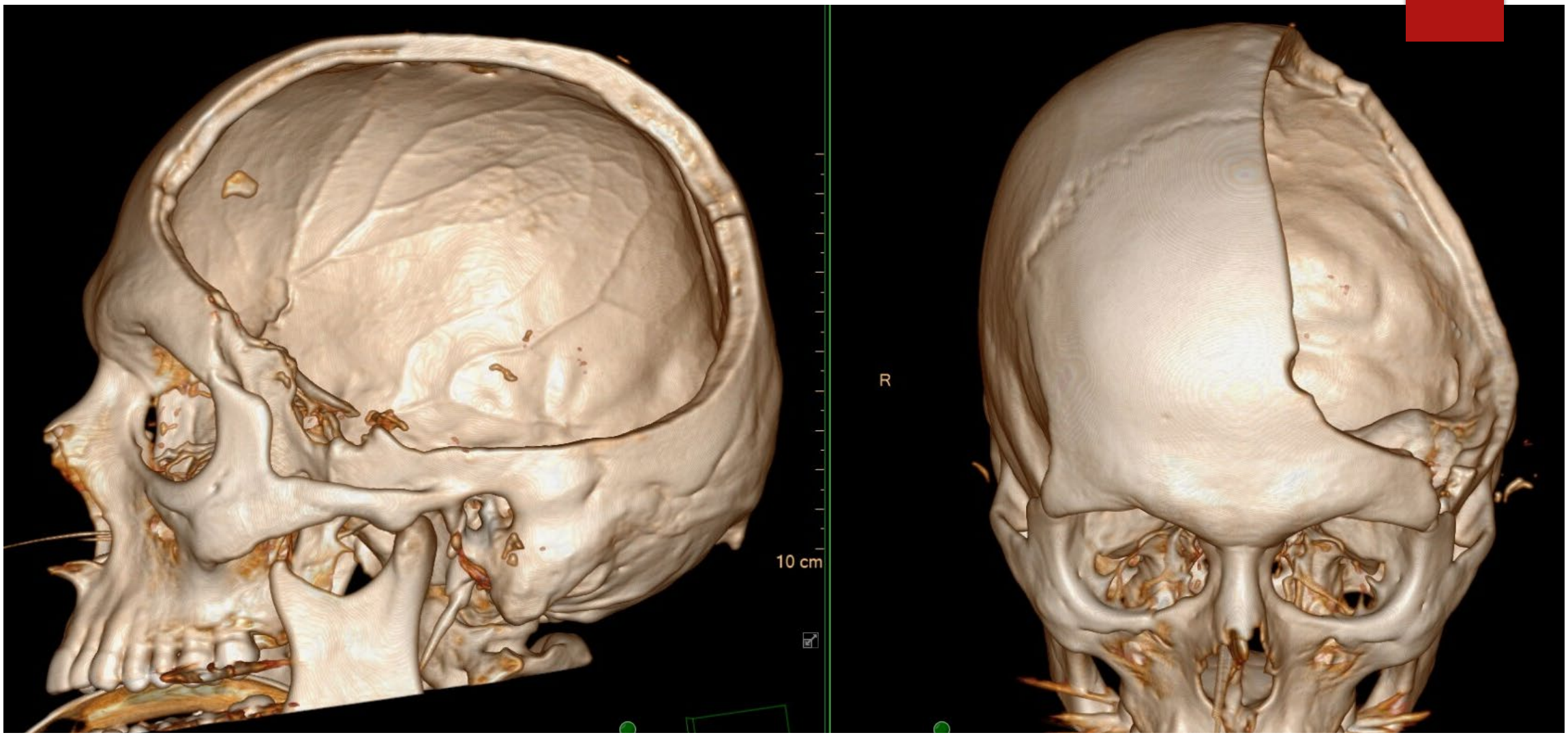
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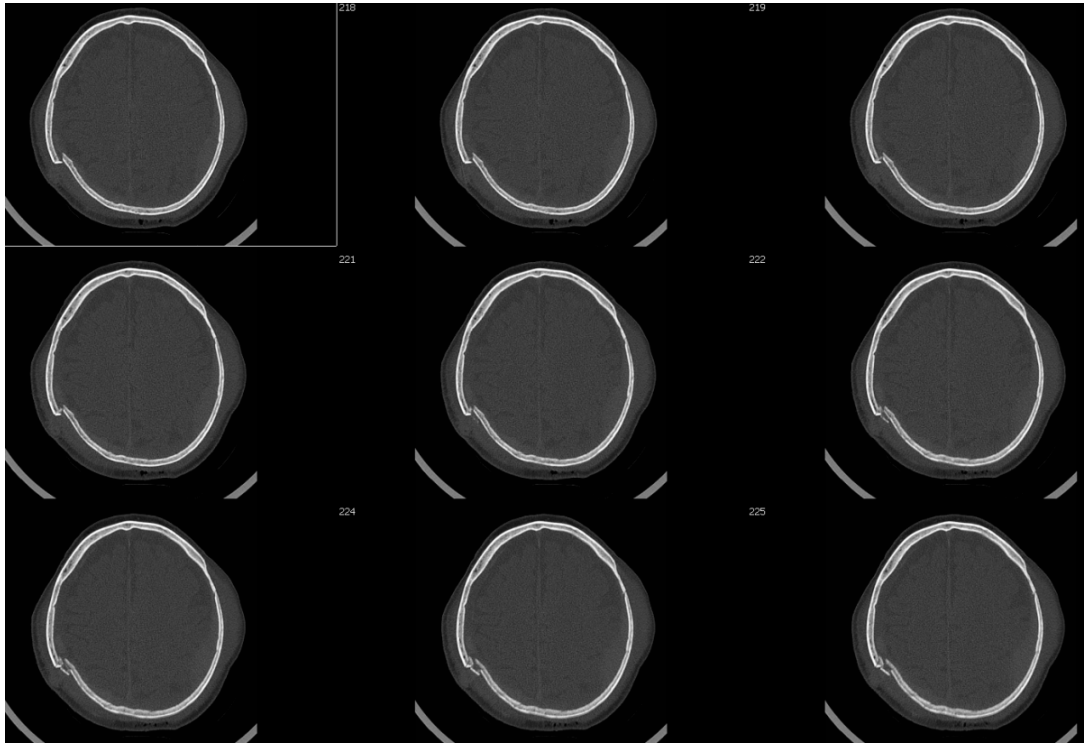
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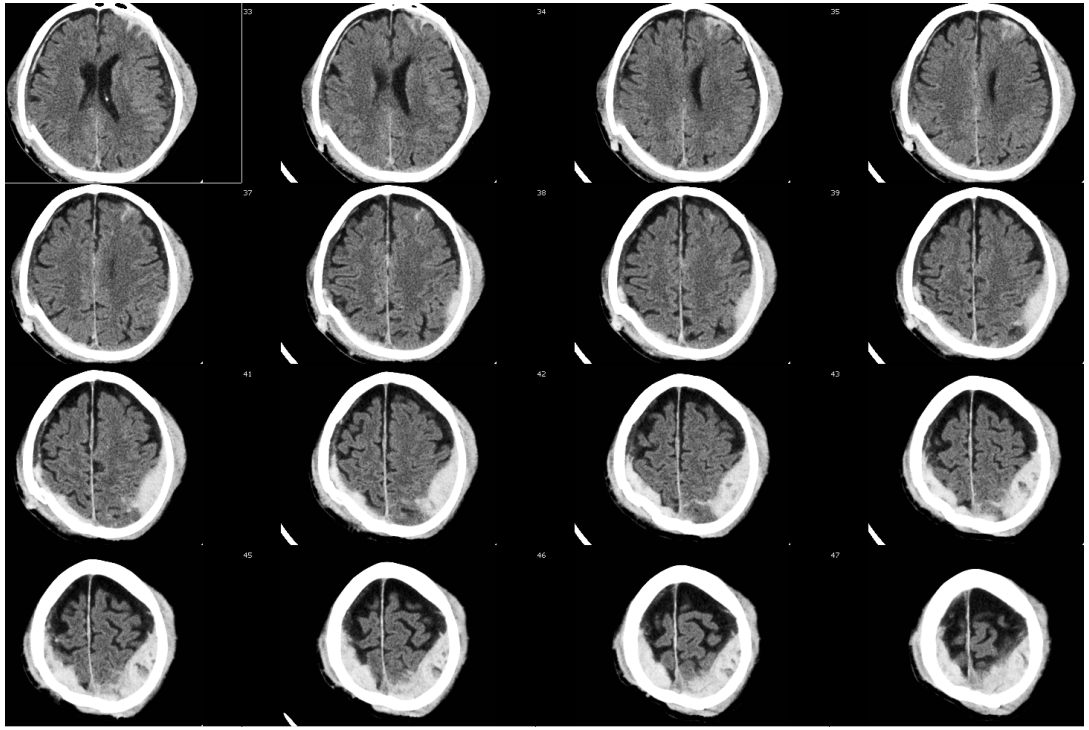
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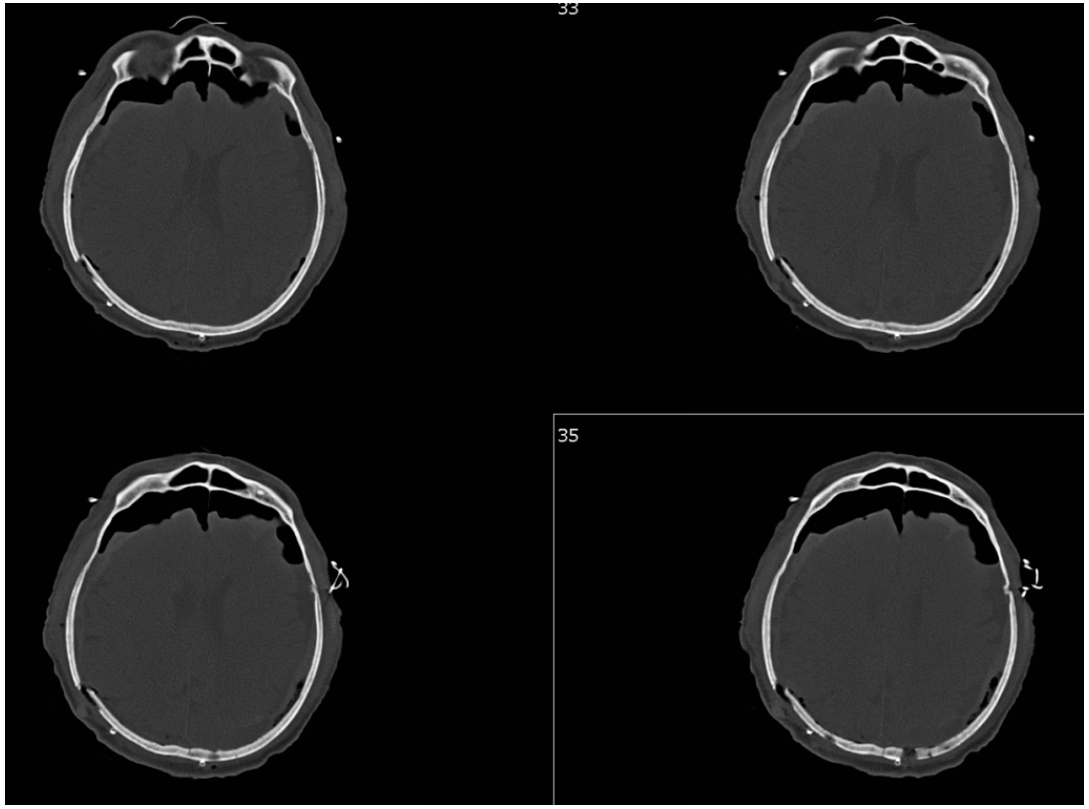
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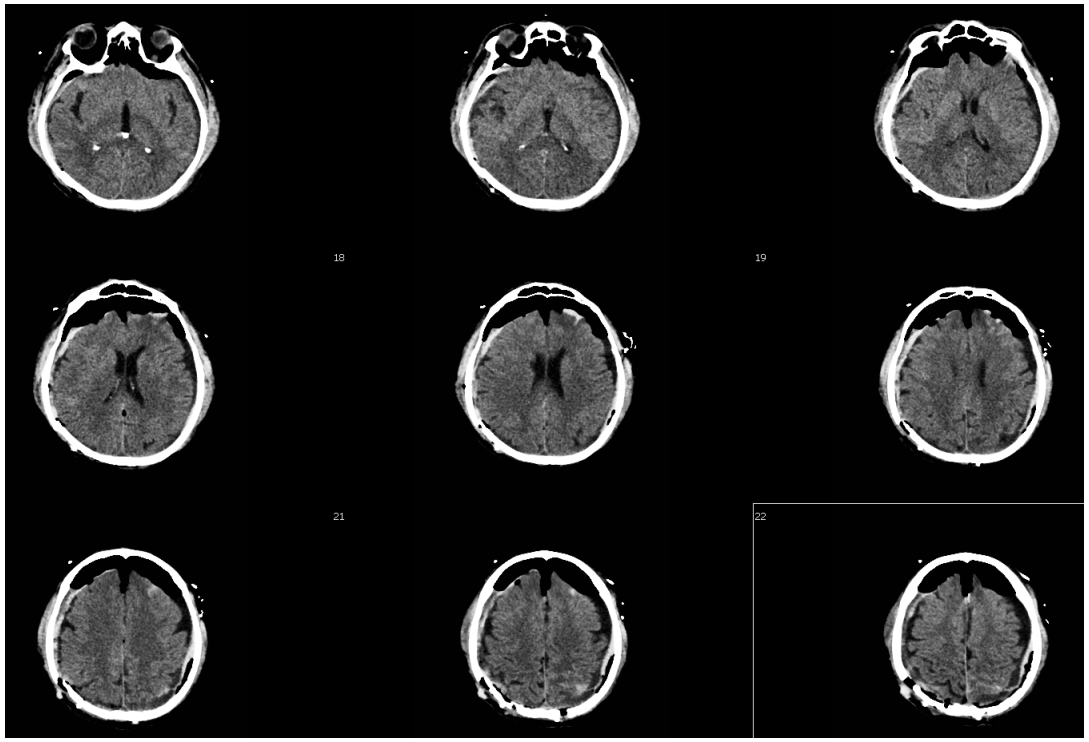
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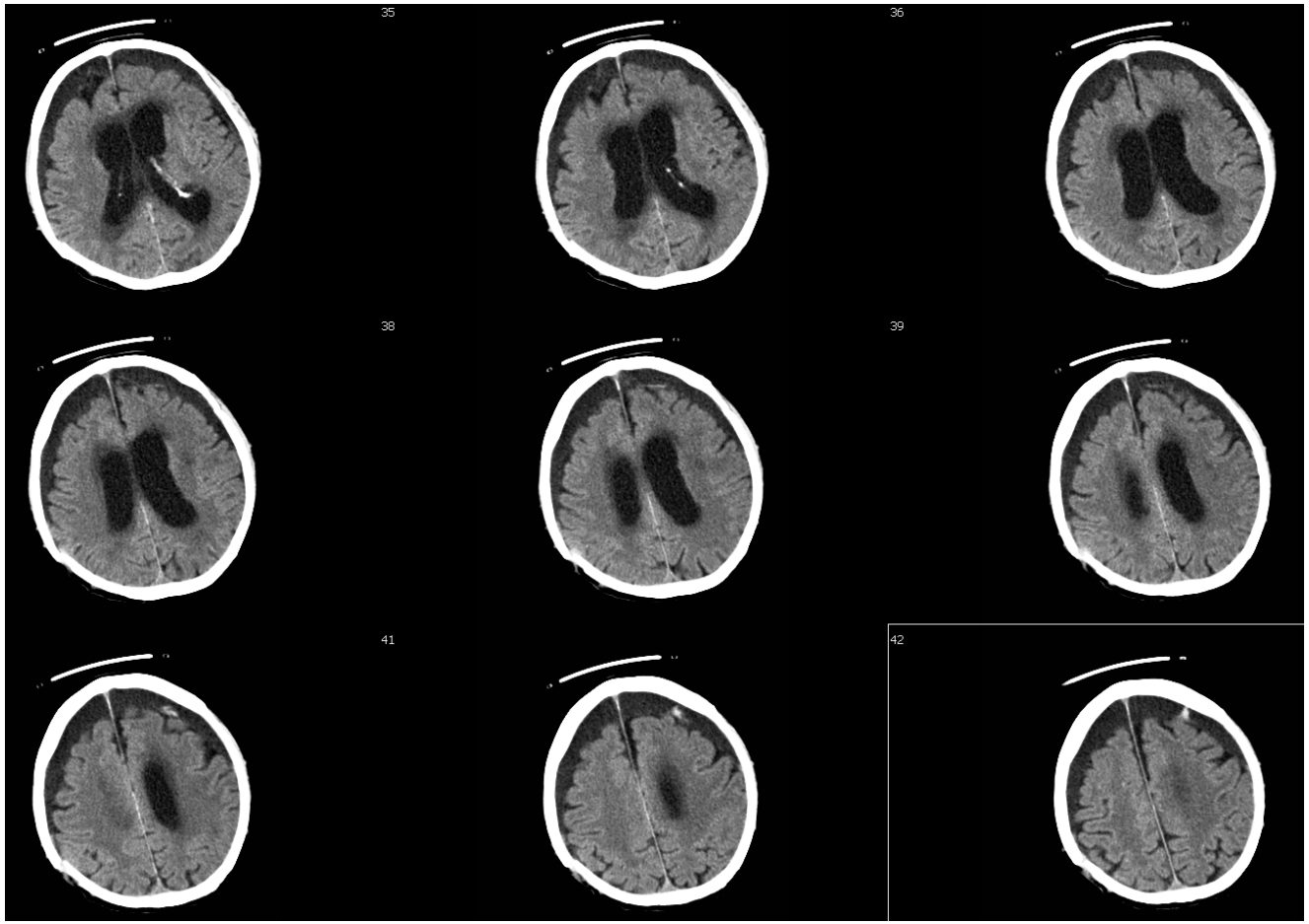
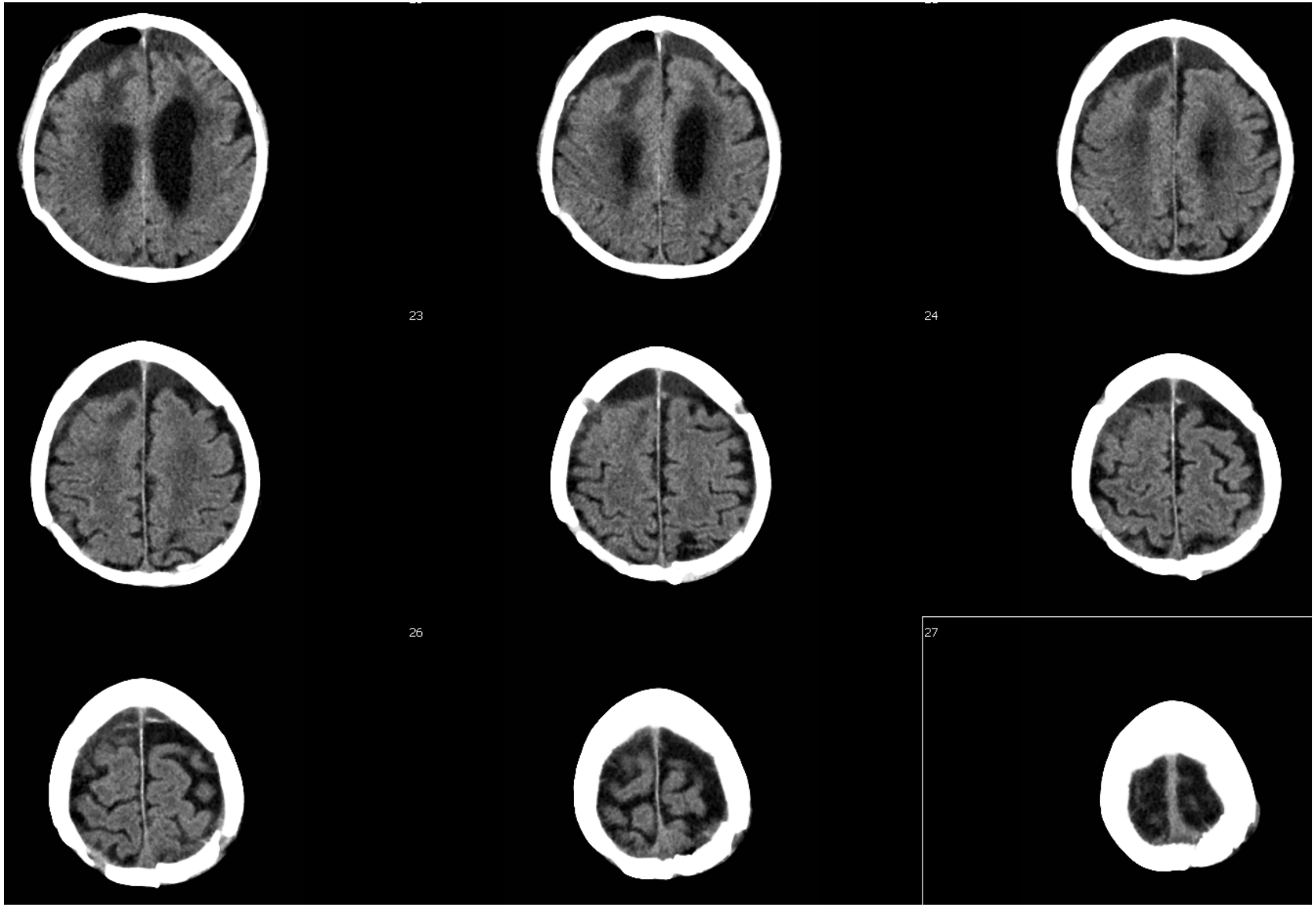


CT po osmi týdnech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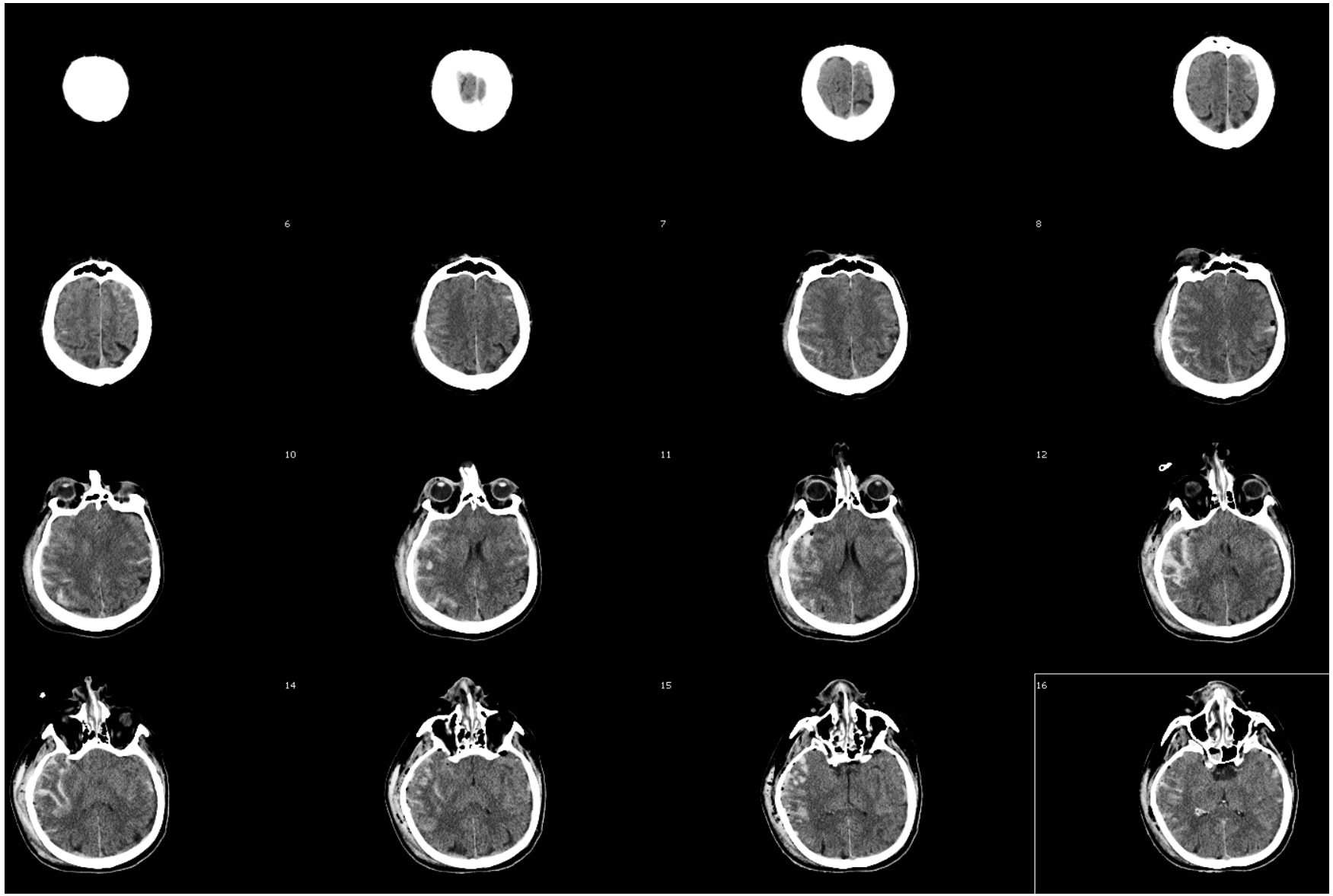
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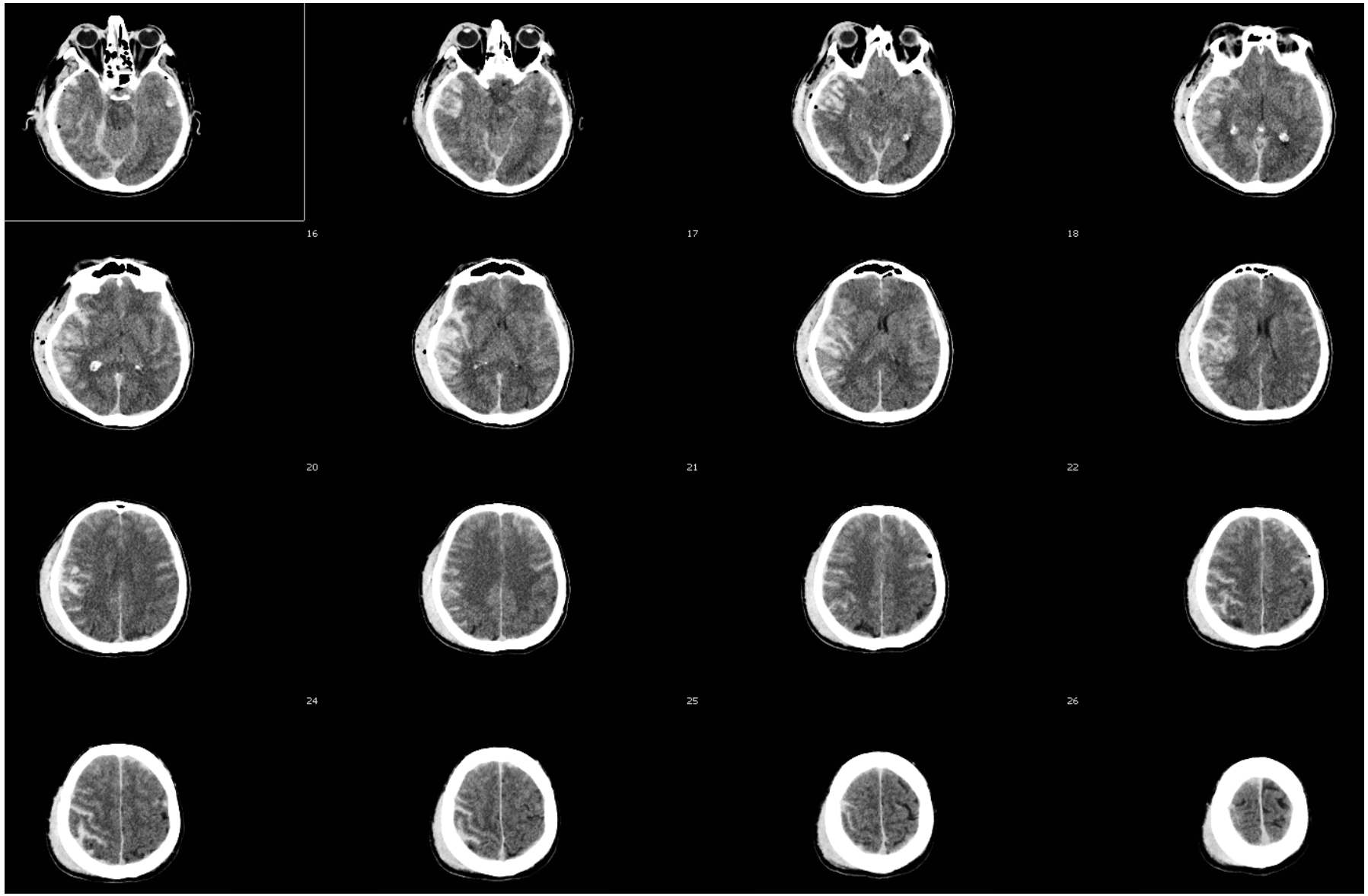
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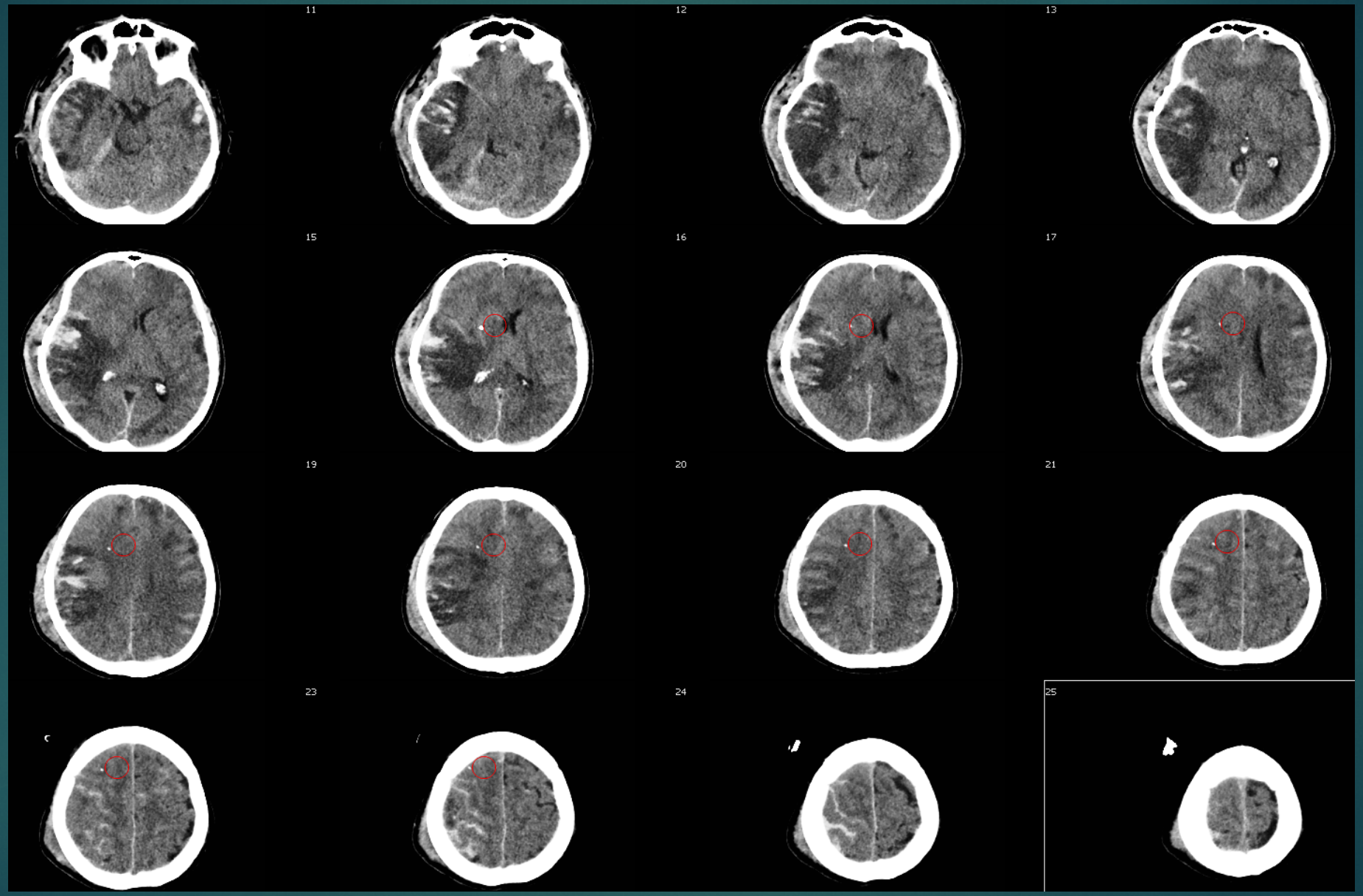
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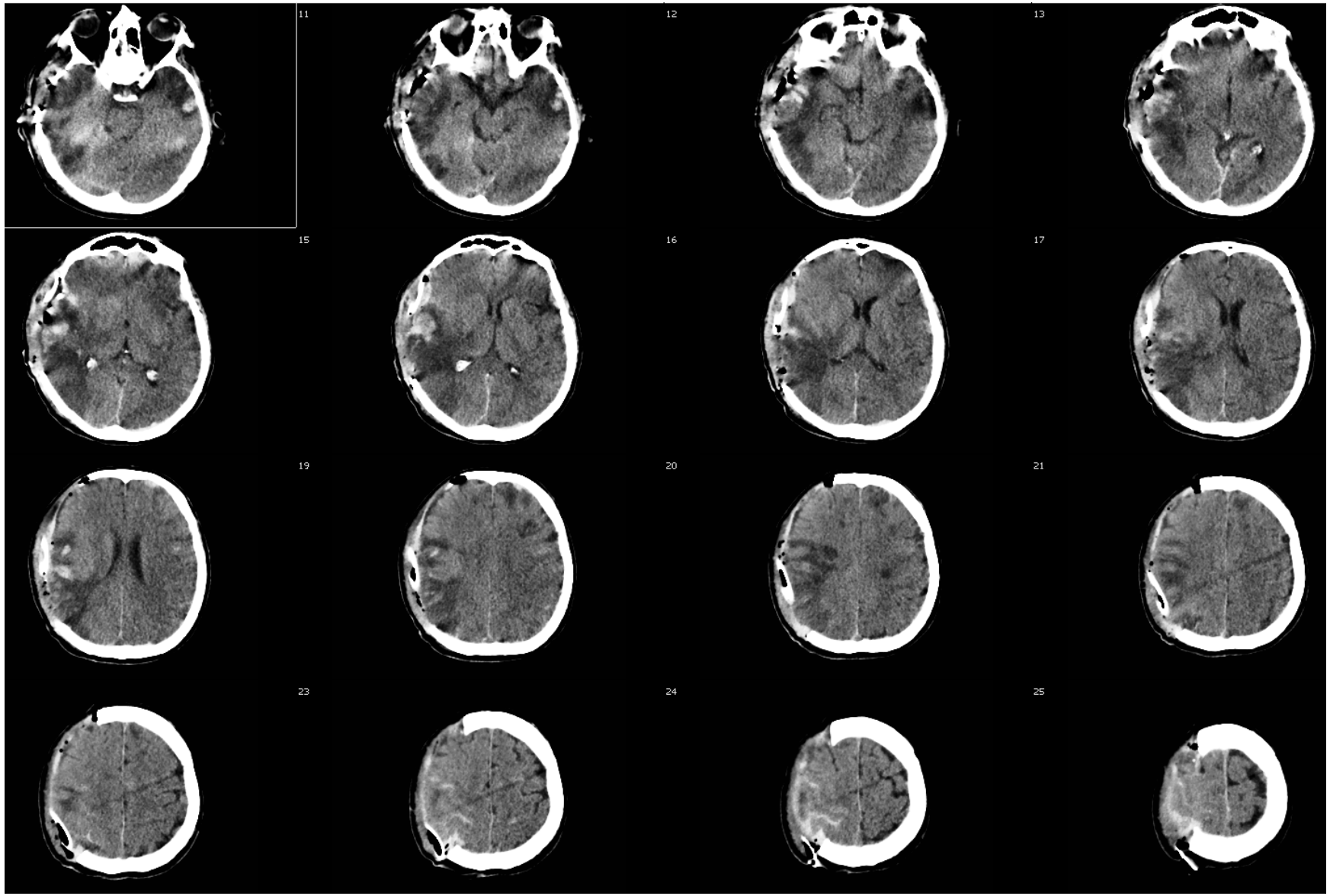
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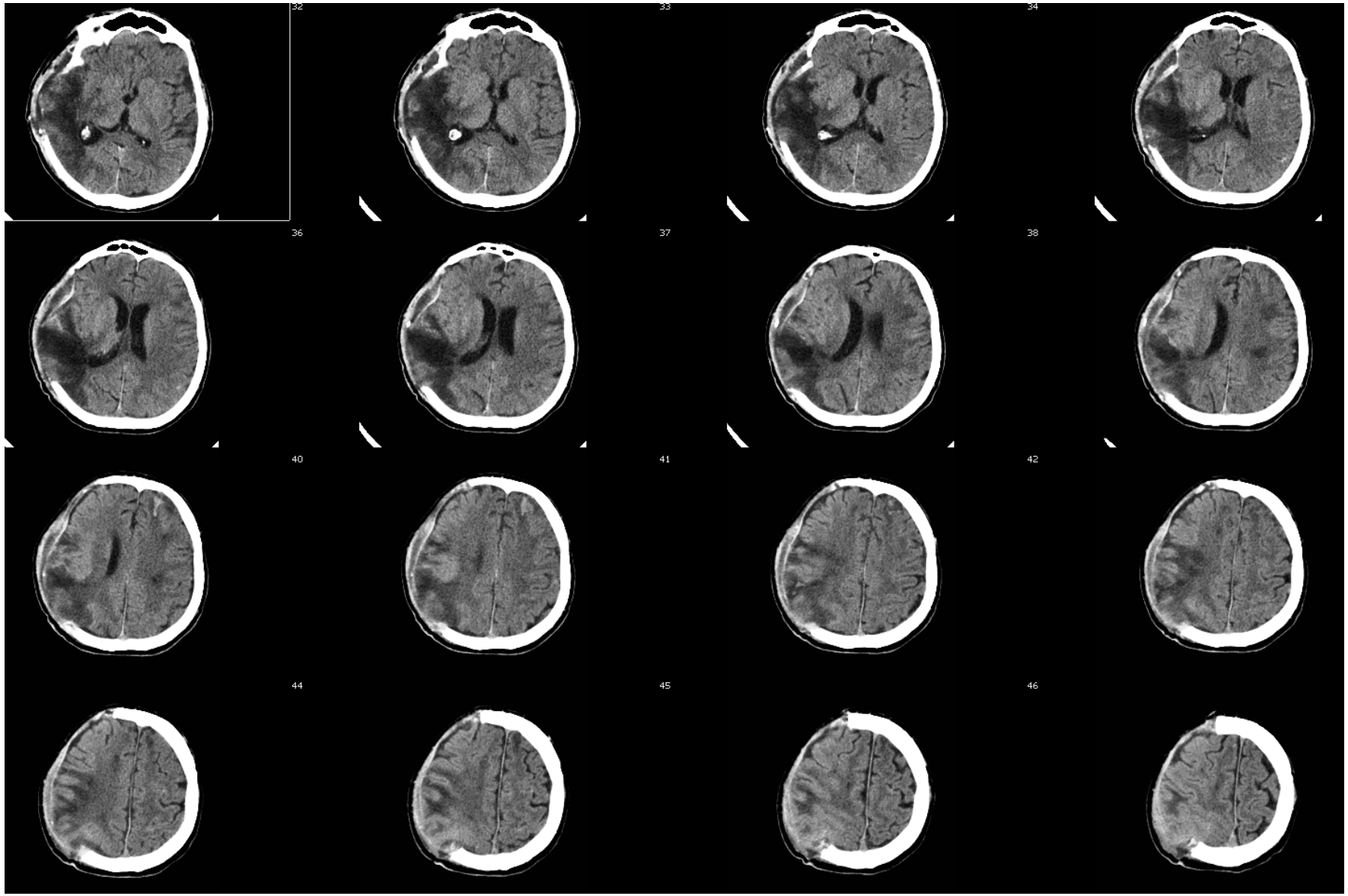
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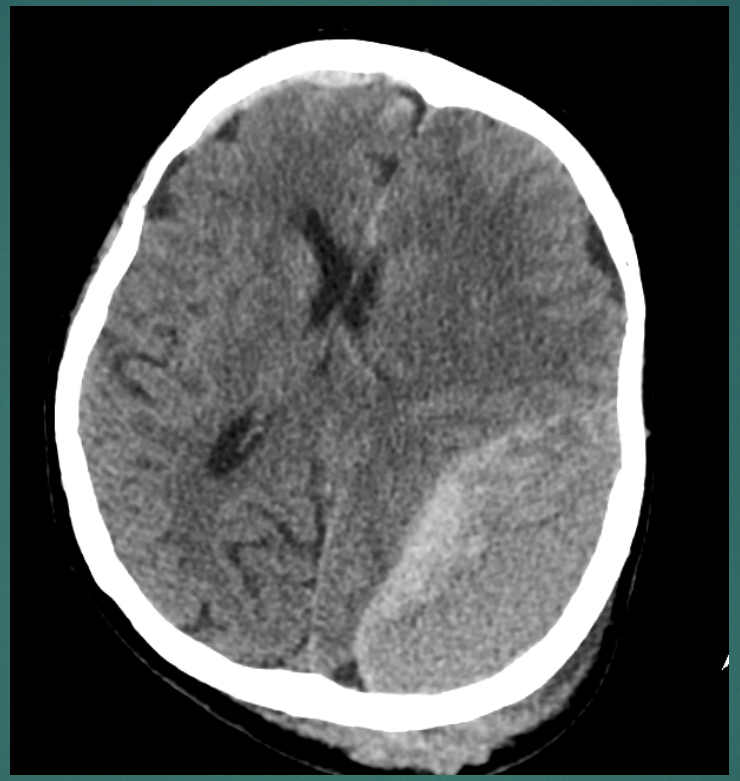
Epidurální hematom

Žena 1953, alkohol + pád

18.05. 21:30



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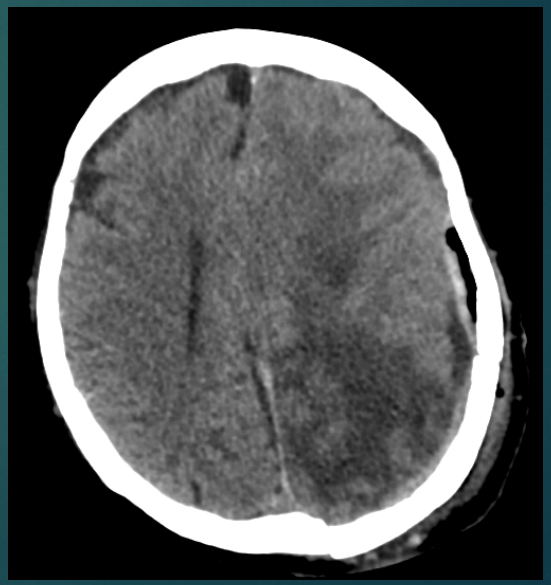

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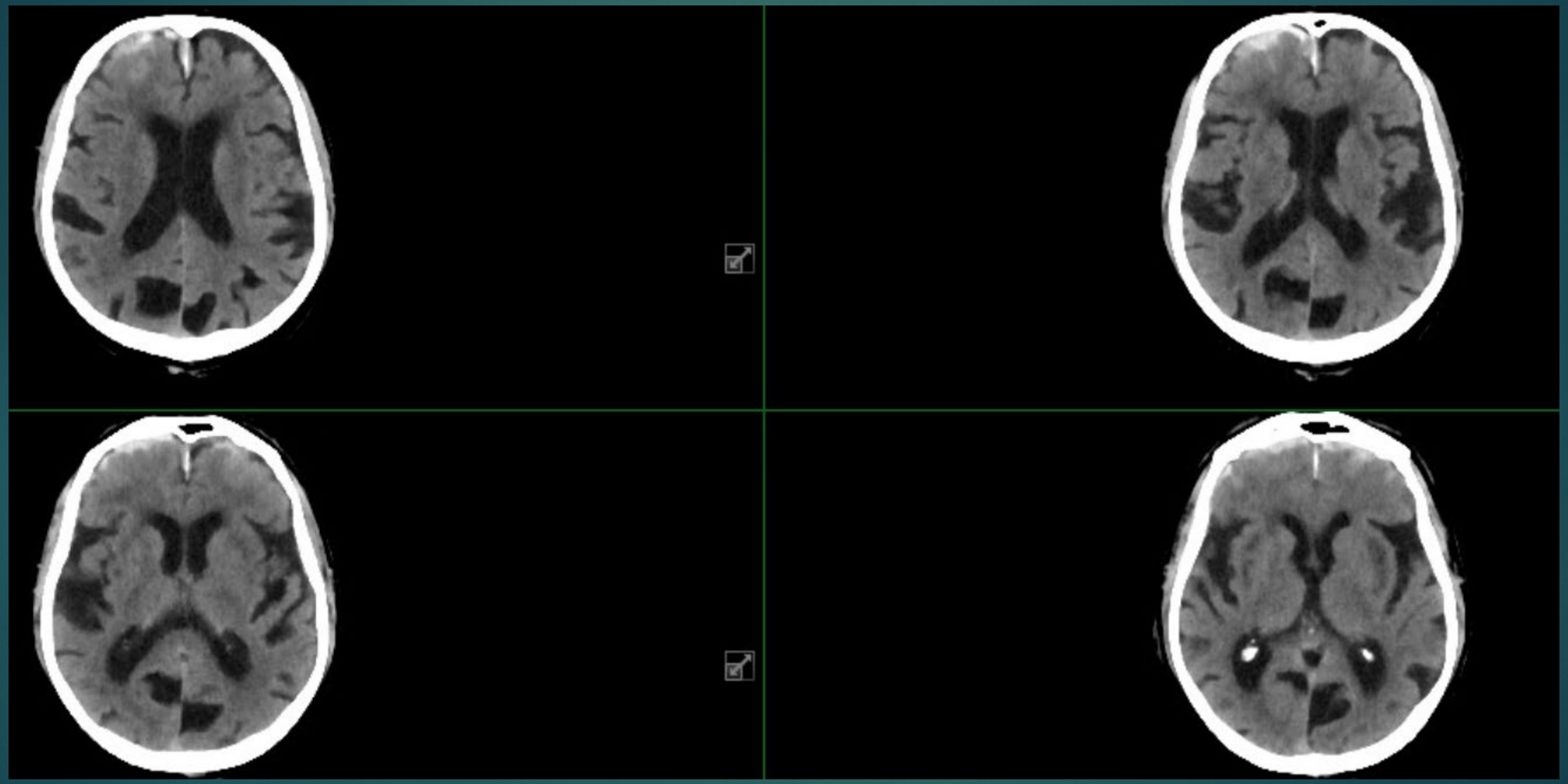
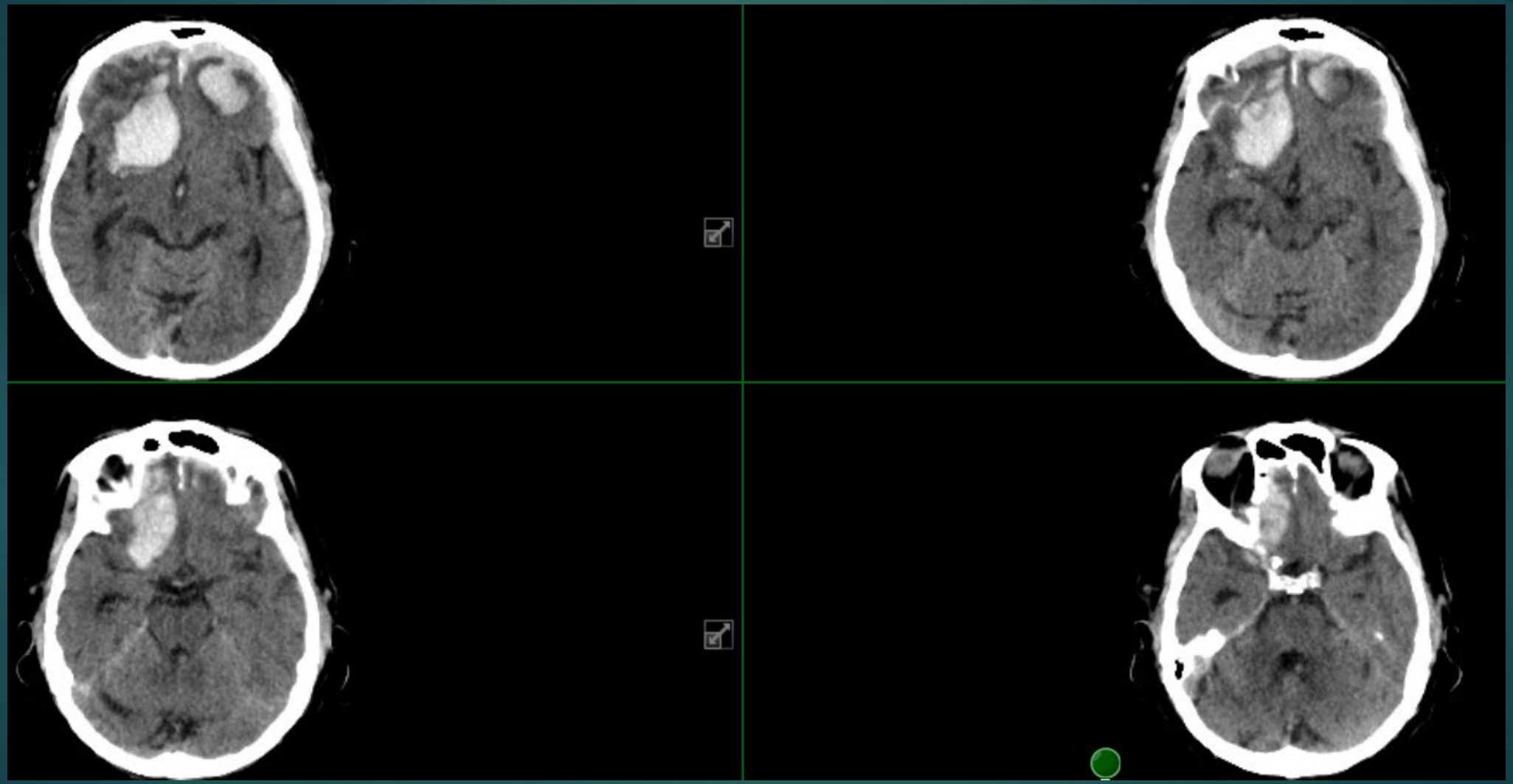
Traumatické subarachnoidální krvácení



Pacient 80 let, pád nejasné etiologie, srdeční slabost, synkopa?

Traumatické subarachnoidální



CT po 4 hodinách

You don't want your neurosurgeon to have doubts about the meaning of it all while he or she is operating on your brain.

Intensive Care Med (2022) 48:649–666
https://doi.org/10.1007/s00134-022-06702-4

NARRATIVE REVIEW

Management of moderate to severe traumatic brain injury: an update for the intensivist

Geert Meyfroidt[1*], Pierre Bouzat[2], Michael P. Casaer[1], Randall Chesnut[3], Sophie Rym Hamada[4], Raimund Helbok[5], Peter Hutchinson[6], Andrew I. R. Maas[7], Geoffrey Manley[8], David K. Menon[9], Virginia F. J. Newcombe[9], Mauro Oddo[10], Chiara Robba[11], Lori Shutter[12], Martin Smith[13], Ewout W. Steyerberg[14], Nino Stocchetti[15], Fabio Silvio Taccone[16], Lindsay Wilson[17], Elisa R. Zanier[18] and Giuseppe Citerio[19,20]

- Přednemocniční fáze
- Rychlá „triage“ pacientů

Parameter	Values/targets	Objectives
Blood pressure	MAP > 80 mmHg SBP > 100 or 110 mmHg	Preserving CBF
SpO_2	> 90%	Avoiding brain hypoxia
$EtCO_2$	30–35 mmHg	Preserving CBF
Hb	> 7 g/dl	Avoiding brain hypoxia
Anticoagulant	Reversal	Limiting blood loss and expansion of hemorrhagic contusions

Synapse ICU

146 ICUs 42 krajin

6 měsíční mortalita byla signifikantně nižší u pacientů s ICP monitoringem ($p<0.0001$)

22 mm Hg

CPP!

60 – 70 mm Hg

BP – euvolemia nebo hypervolemia v první řadě (vazopresory)

Table 2 Proposed target values for some neuromonitoring modalities

	Normal	Desirable	Critical
ICP	~10 mmHg	<18–22 mmHg	>25 mmHg
CPP	50–60 mmHg	60- (80) mmHg	<50 mmHg
$PbtO_2$	~30 mmHg	20–25 mmHg	<15 mmHg
Lactate/Pyruvate Ratio	<25	<25	>40
Brain Glucose	>1 mmol/l	>0.8 mmol/l	<0.5 mmol/l
Brain temperature	~36.5 °C	36.5–37 °C	>37.5 °C

Evidence for these target values is derived from associations between targets and outcome. Evidence from randomized controlled trials that treating TBI patients according to these target values impacts their outcomes is currently lacking

ICP intracranial pressure; *CPP* cerebral perfusion pressure; *$PbtO_2$* brain tissue oxygen

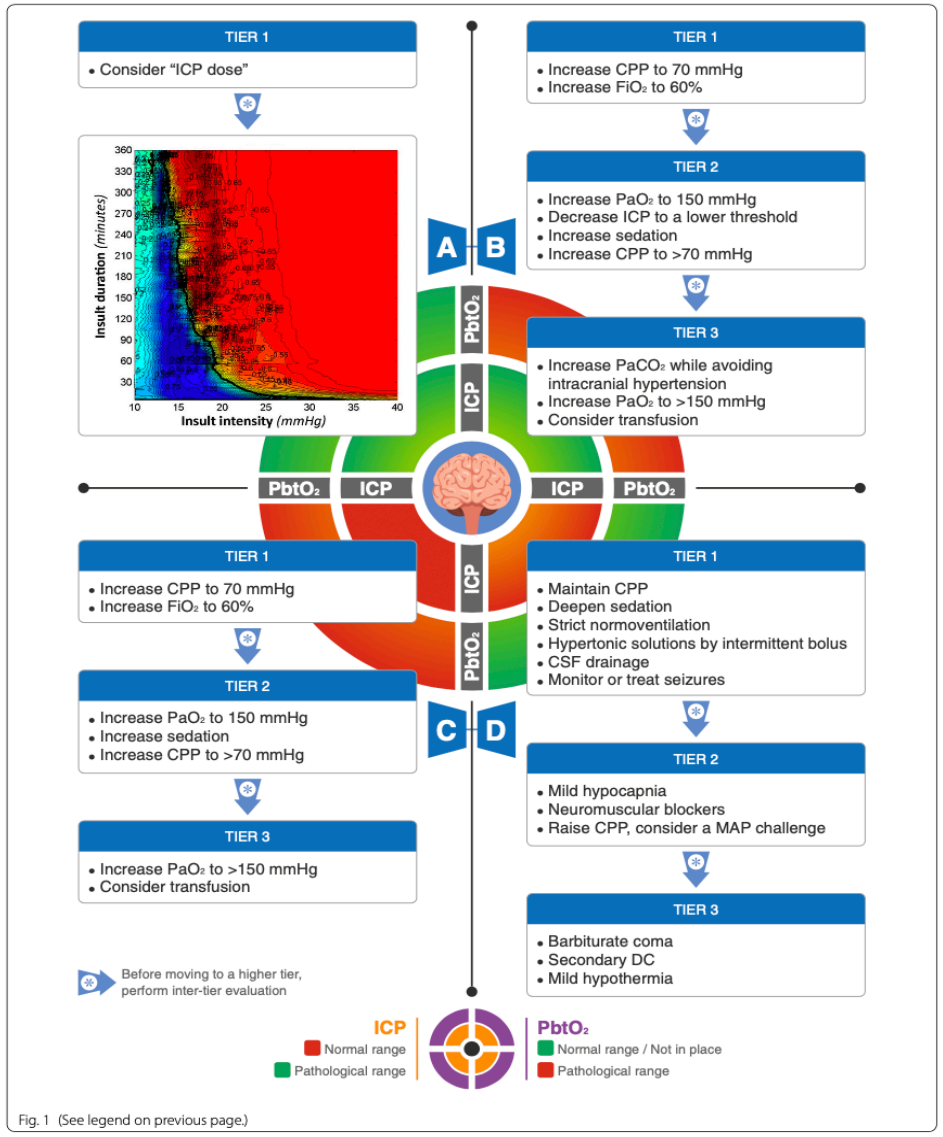


Fig. 1 (See legend on previous page.)

Systemic secondary insults		Intracranial secondary insults	
Events	Main causes	**Events**	Main causes
Hypoxaemia	• Hypoventilation • Thoracic injury • Aspiration pneumonia • Anaemia	**Raised intracranial pressure and/or brain shift**	• Mass lesion • Vasodilation • Impaired cerebral venous drainage (position, ET tube ties, coughing etc.) • Oedema • Hydrocephalus
Hypotension	• Hypovolaemia • Cardiac failure • Sepsis • Spinal cord injury	**Vasospasm Stroke/infarction**	• Traumatic subarachnoid haemorrhage?
Hypercarbia	• Respiratory depression	**Seizures**	• Cortical brain injury
Hypocarbia	• Hyperventilation, spontaneous or induced	**Infection**	• Skull base fracture • Compound depressed skull fracture
Hyperthermia	• Hypermetabolism • Stress response • Infection		
Hyperglycaemia	• Hypothermia • IV dextrose infusion • Stress response		
Hypoglycaemia	• Inadequate nutrition		
Hyponatraemia	• SIADH • CSW		

Table 4 Management of severe TBI: conceptual highlights

Initial management	
Initial pre-and in-hospital resuscitation	Avoid and treat hypotension, hypoxia, anemia
Secondary injury management	
Management of elevated ICP	ICP monitoring allows to titrate therapy to severity of intracranial hypertension in severe TBI patients SIBICC algorithms provide a conceptual framework for a tiered approach Treating TBI involves more than just treating elevated ICP
Management of CPP	Optimizing brain perfusion can be challenging, and ancillary monitoring of brain tissue oxygen or cerebrovascular autoregulation may be helpful
Multimodality monitoring	Should be applied to answer a specific pathophysiological question
Extracranial complications	
Respiratory management	Lung protective ventilation is the preferred strategy Avoid hypoxia, hyperoxia, hypocapnia, hypercapnia
Fluid management	Assessment of volume status like general critically ill patients Choice of optimal hypertonic solution still uncertain
Transfusion	Variation in transfusion triggers reflects lack of evidence
Acute kidney injury	Occurs in 10% of TBI patients and is associated with poor long-term outcomes
Nutrition management	Nutrition management should prioritize the prevention of nutrition induced harm: avoid hyperglycemia, administer micronutrients early on, and delayed enteral nutrition should raise no concern
Mobilization and rehabilitation	Early mobilization is feasible, but benefit is unknown Early rehabilitation referrals might be associated with earlier functional gain
Coagulation management	TXA should be administered in all bleeding multiple trauma patients < 3 h. TXA may be considered in isolated mild-to-moderate but not severe TBI Significant variability in the timing of LMWH initiation exists. Before LMWH can be started, intermittent pneumatic compression should be applied

ICP intracranial pressure, *TBI* traumatic brain injury, *SIBICC* Seattle International Severe Traumatic Brain Injury Consensus Conference. *CPP* cerebral perfusion pressure, *TXA* tranexamic acid, *LMWH* low molecular weight heparin

“Reinkarnace“ multimodálního monitoringu?

- ICP
- LICOX
- PRx
- Autoregulace – TK, ventilační parametry (PaO_2, $PaCO_2$)
- Mikrodialýza

Studie zabývající se benefitem monitoringu tkáňové oxymetrie a cílenou léčbou nízkých hladin O_2

- BOOST II
- BOOST III
- BONANZA
- OXY-TC trial

Open access Protocol

BMJ Open

Brain Oxygen Optimization in Severe Traumatic Brain Injury (BOOST-3): a multicentre, randomised, blinded-endpoint, comparative effectiveness study of brain tissue oxygen and intracranial pressure monitoring versus intracranial pressure alone

Francis Bernard ,[1,2] William Barsan,[3] Ramon Diaz-Arrastia,[4] Lisa H Merck,[5] Sharon Yeatts,[6] Lori A Shutter [7]