MADRID 2014 ESMO congress

UniversityHospital Heidelberg

Challenges and pitfalls in radiological response assessment of brain metastases

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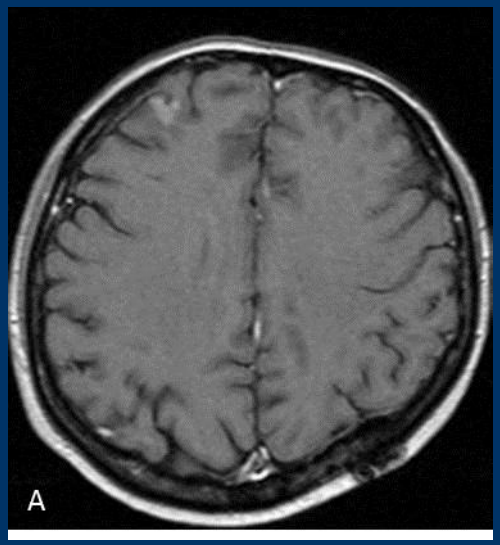
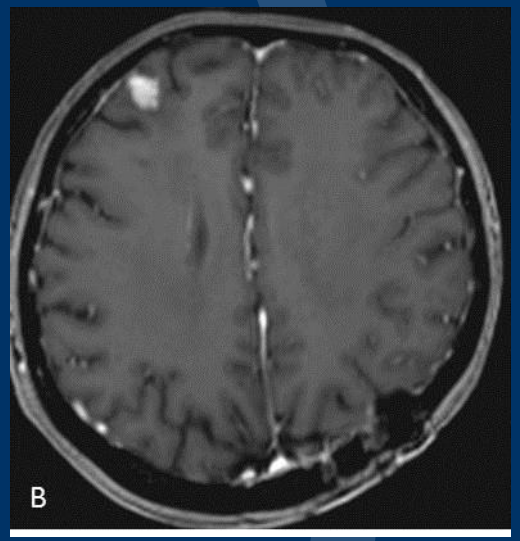
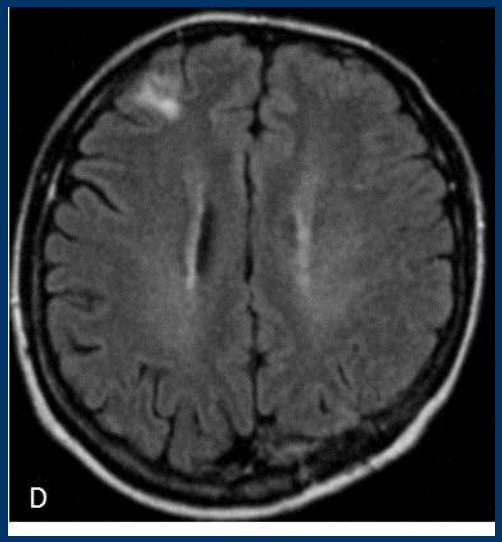
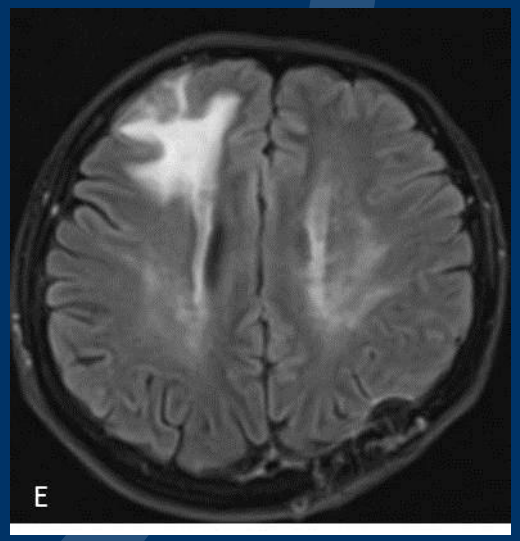
Patient 1: Melanoma BM

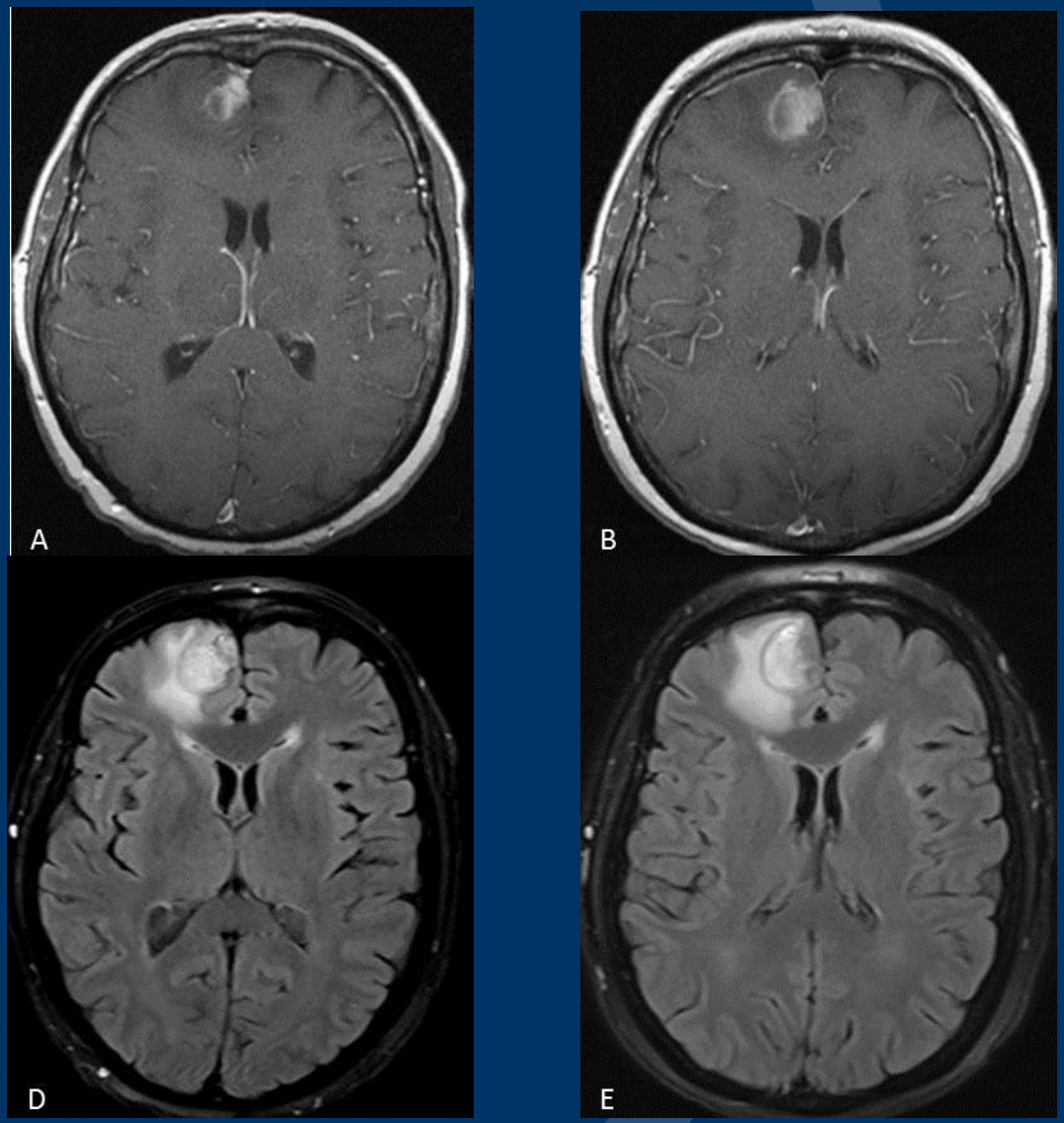




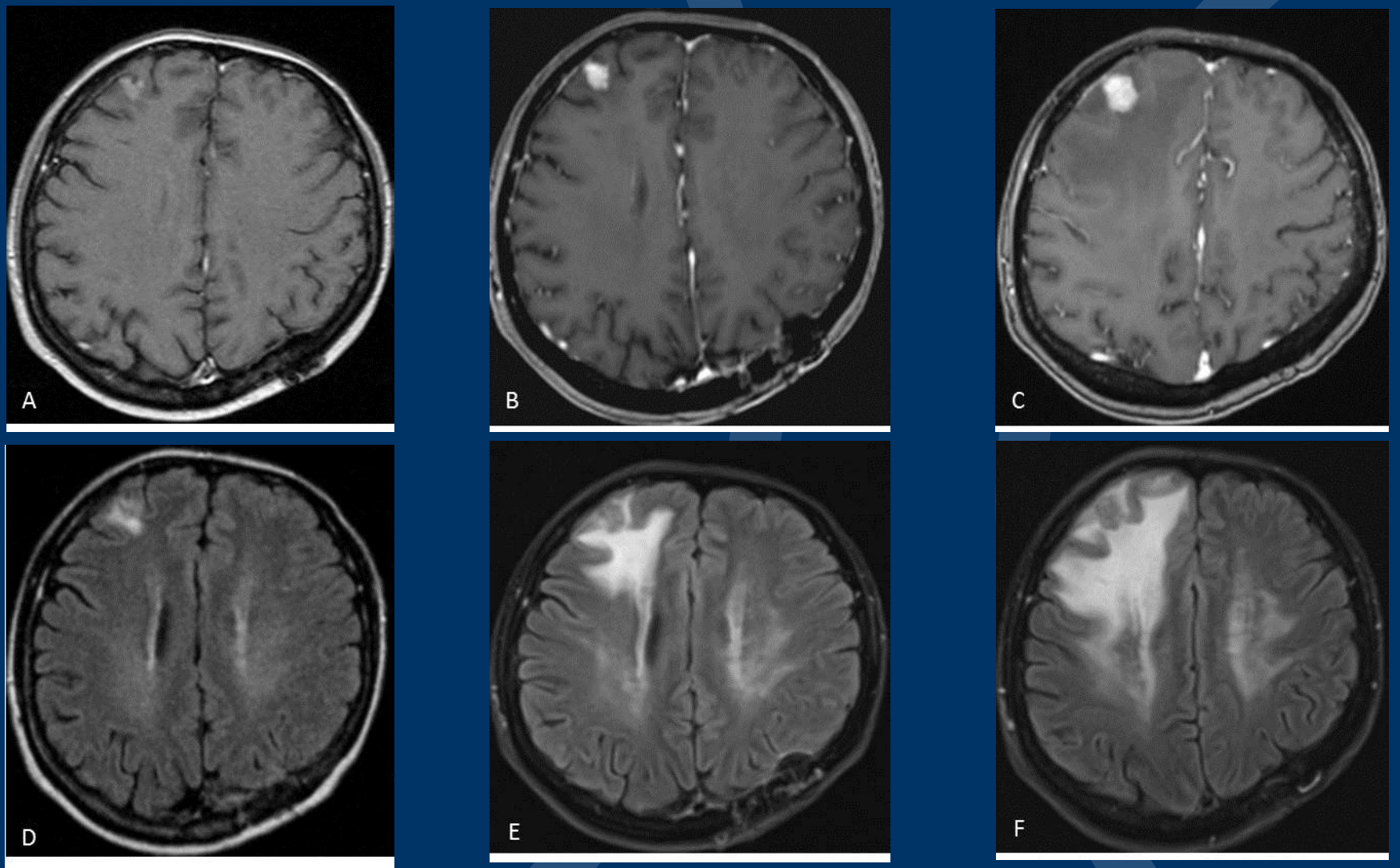




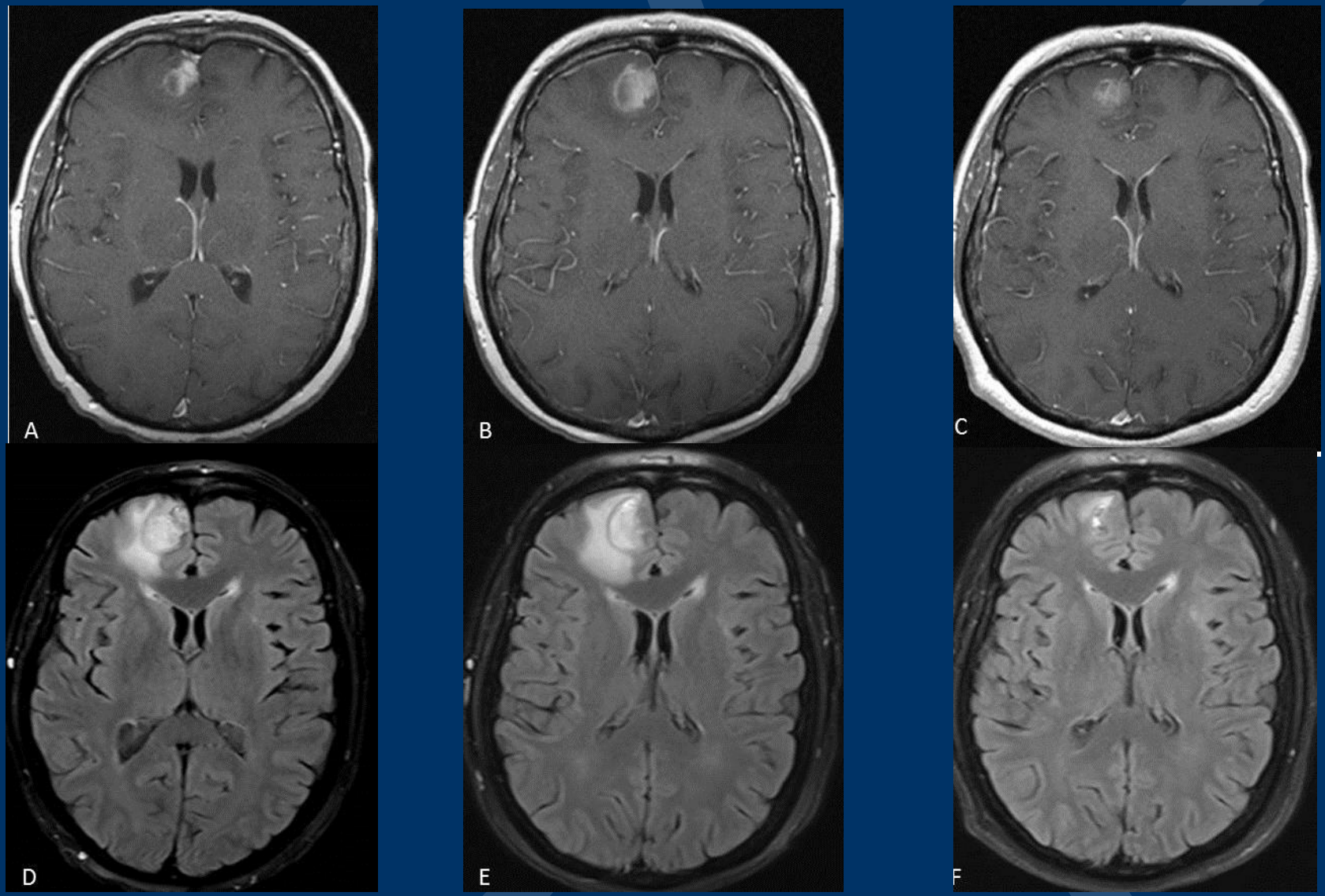
Patient 2: Melanoma BM



Patient 1: True Progression

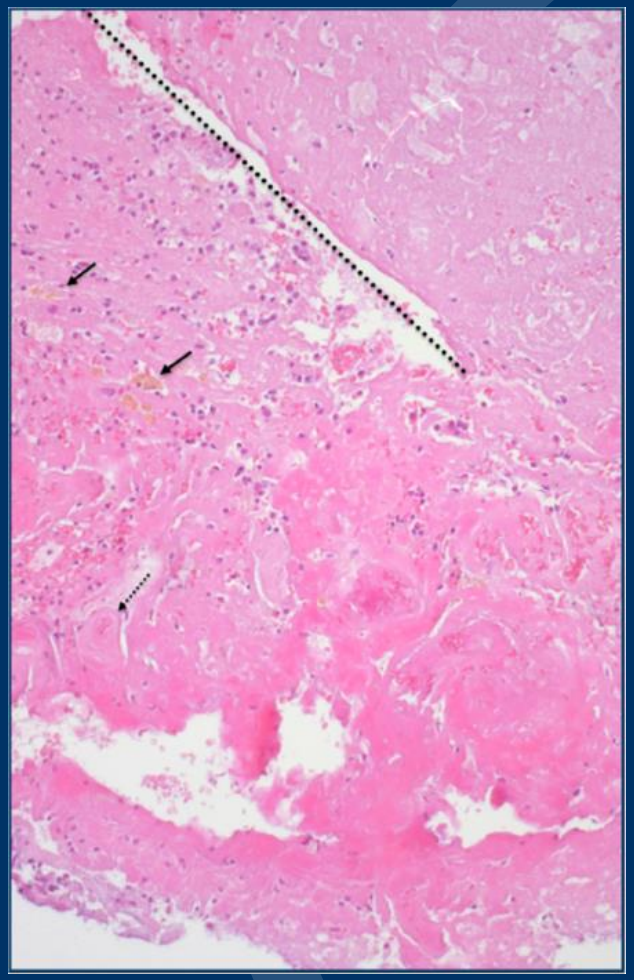


Patient 2: Radiation Necrosis



Radiation Necrosis

- After stereotactic radiosurgery (SRS) or radiation
- Can occur weeks to months after SRS

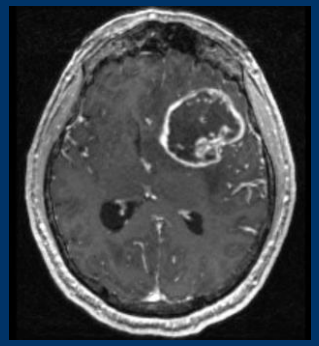


Kickingereder et al. Radiation Oncology 2013, 8 :52

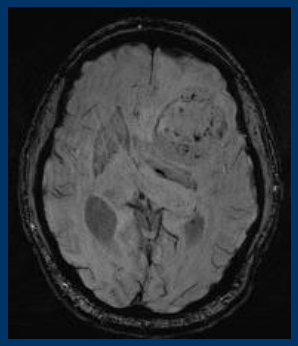
Guidance in the case of uncertain attribution of radiographic findings according to proposed RANO (BM)

1. Repeat the scan at the next protocol scheduled evaluation
2. Histopathological evaluation
3. Advanced MR/PET Imaging techniques

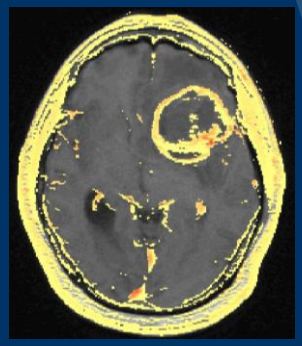
Advanced MR Imaging



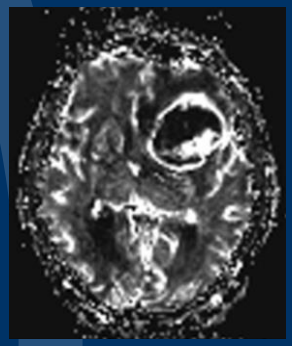
ce-T1



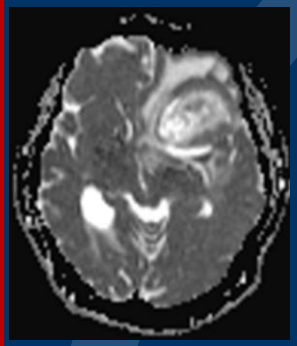
SWI



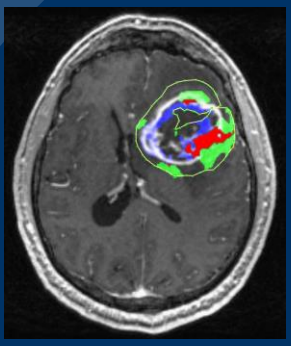
DCE-Perfusion



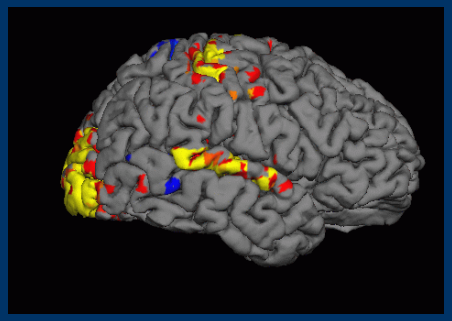
DSC-Perfusion



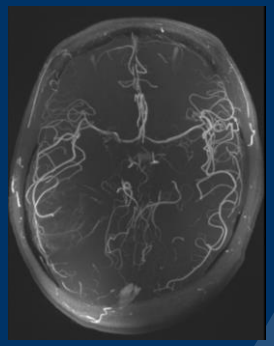
Diffusion



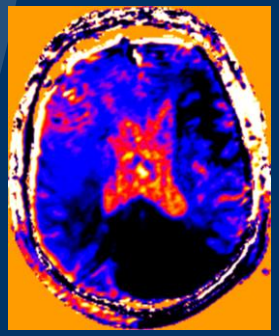
Advanced Postprocessing



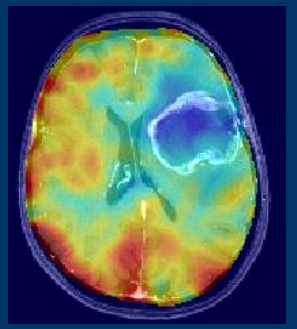
FMRI



Ultra High Field: 7 Tesla



CEST (pH Imaging?)

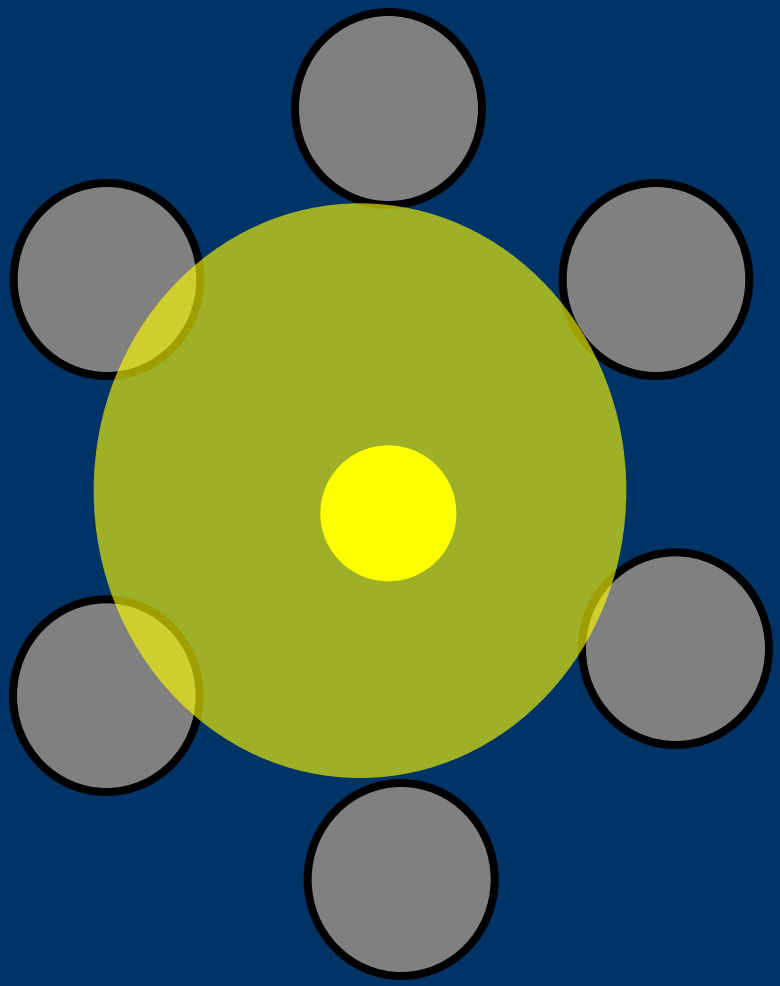


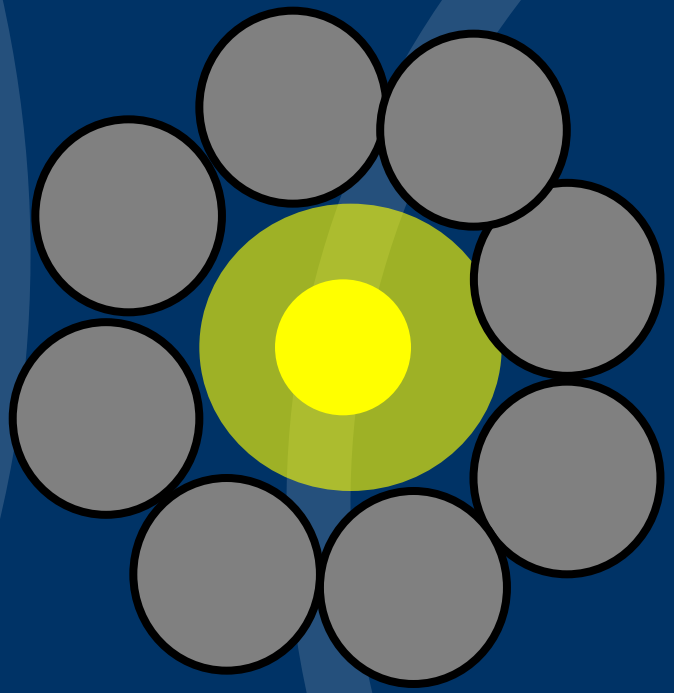
X-Nuclei Imaging (O17)

Diffusion MRI

- Mostly used: Apparent Diffusion Coefficient (ADC)
- ADC is supposed to reflect tumor cellularity
- Low ADC is correlated with high vascularity - true progression

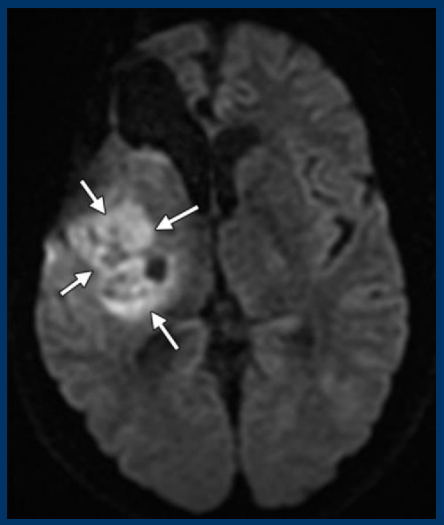
Calculation of ADC

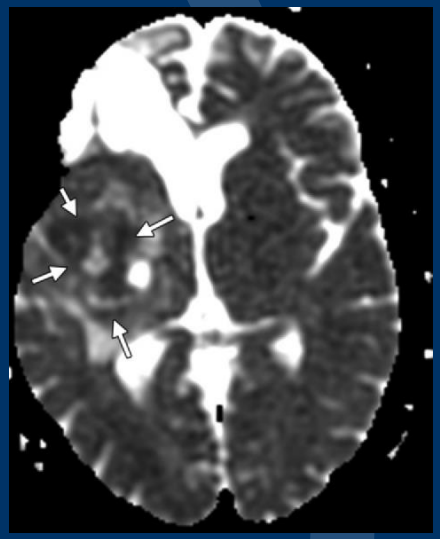




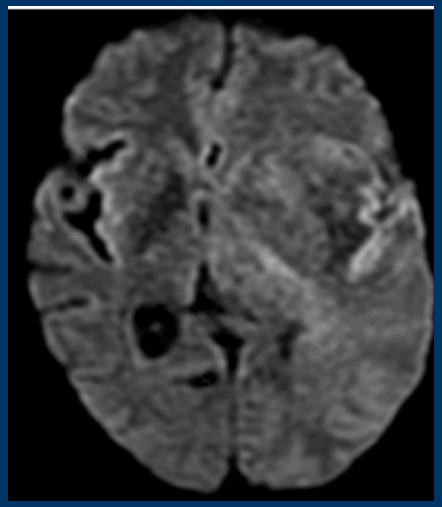
Low Cellularity- High ADC

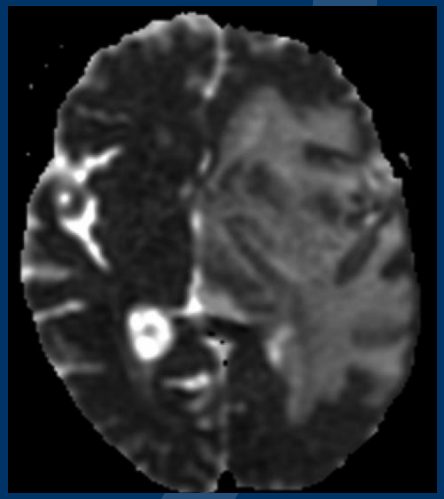
High Cellularity – Low ADC





High Cellularity
Low ADC
True Progression





Low Cellularity
High ADC
Radiation Necrosis

Shah et al, Radiation necrosis in the brain: imaging features and differentiation from tumor recurrence, Radiographics. 2012 Sep-Oct;32(5):1343-59

Perfusion MRI

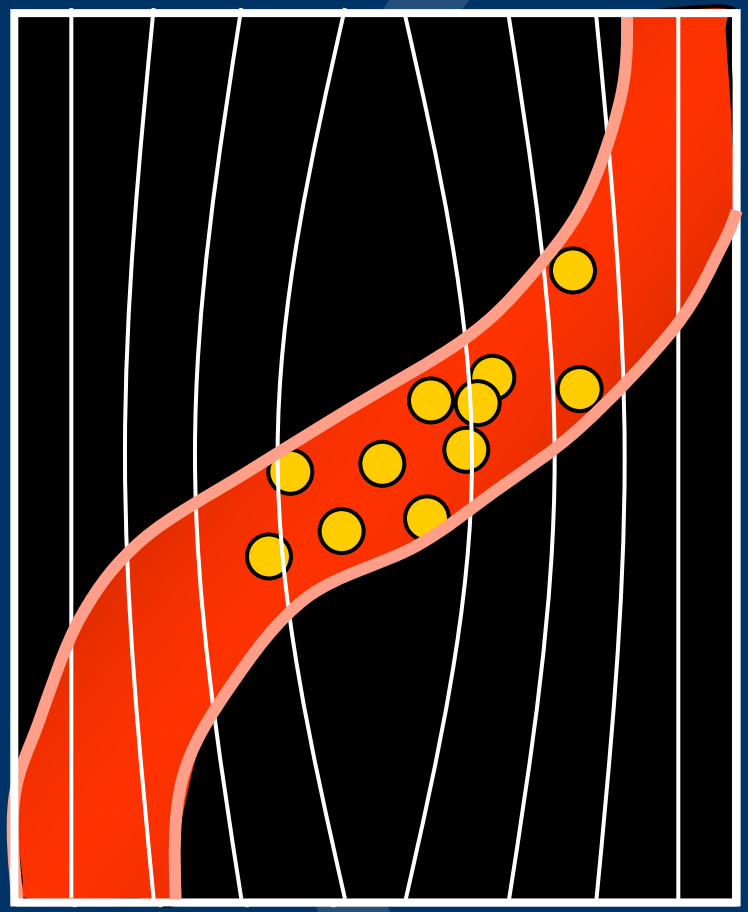
- Mostly used parameter: Cerebral Blood Volume (CBV)
- CBV reflects vascularity of the tumor
- High CBV is correlated with high vascularity and true progression

Principle of Dynamic Susceptibility Contrast Enhanced Perfusion

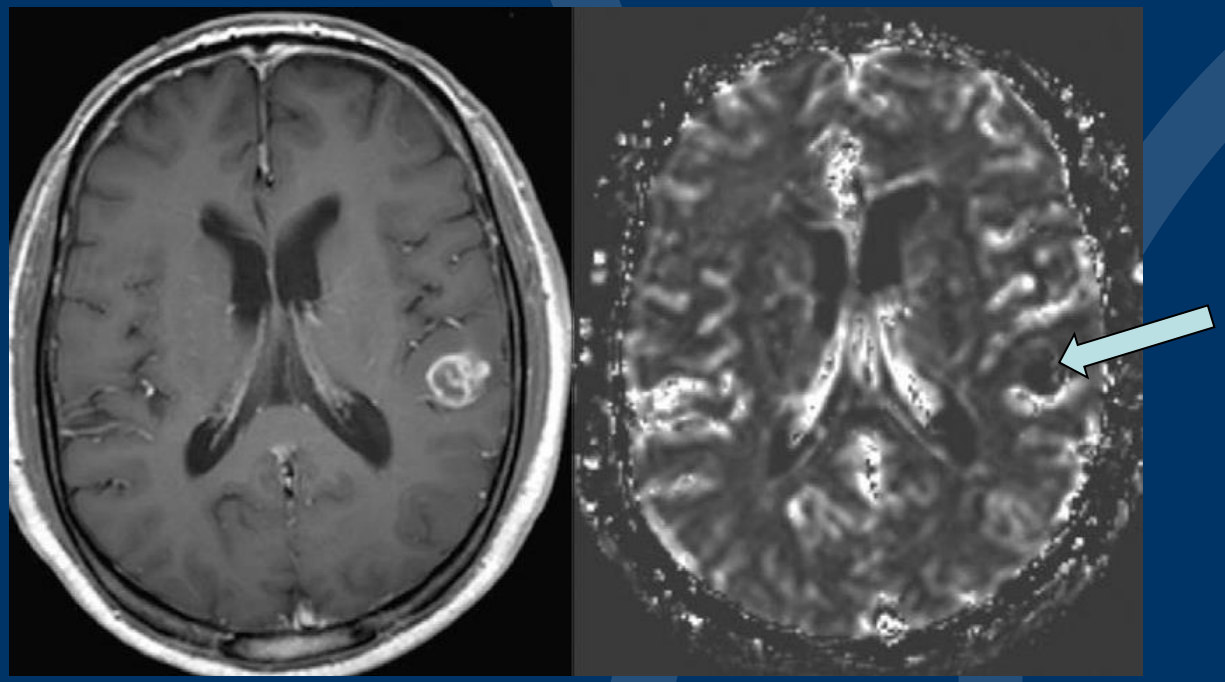
T2*-Effect

- Paramagnetic contrast agent causes inhomogeneties of magnetic field:

- Long distance effect



Identification of Radiation Necrosis



New Enhancement in follow up Examination after radiosurgery

Low CBV – radiation necrosis
High CBV -progress

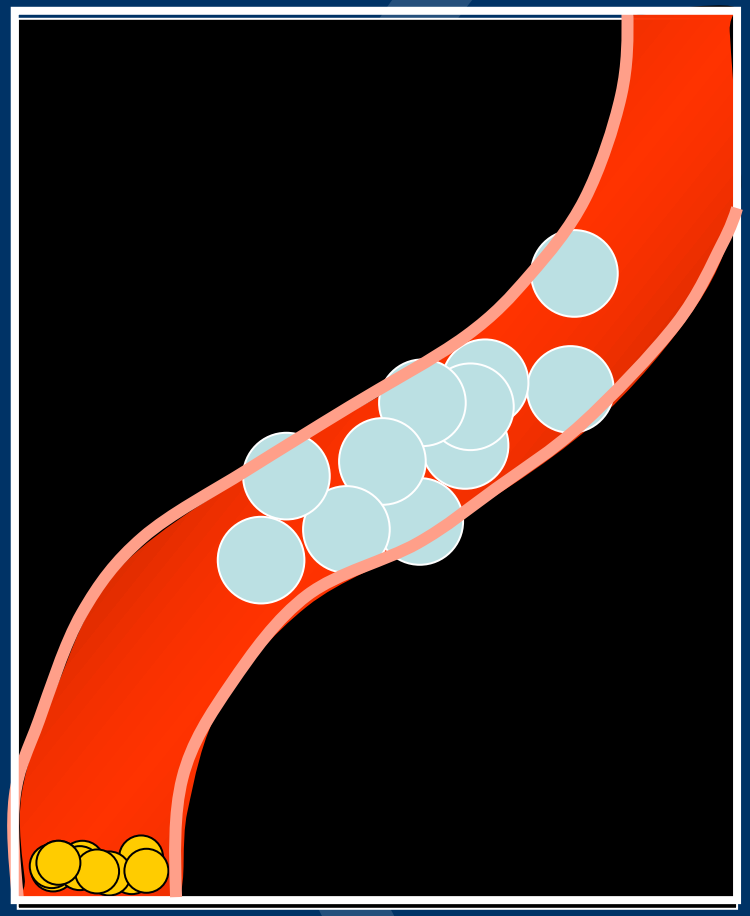
Underestimation of CBV

Kang et al, Morphological and functional MRI, MRS, perfusion and diffusion changes after radiosurgery of brain metastasis, Eur J Radiol 2009

Problem: T1-Effect of Contrast Agents

T1-Effect:

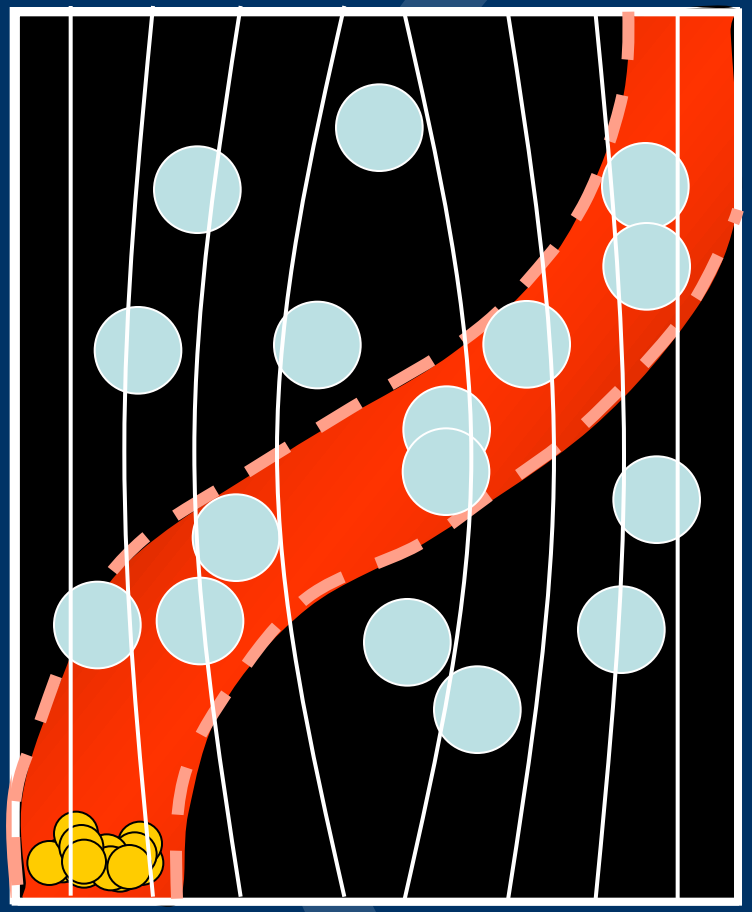
- short distance effect
- antagonistic to T2*-effect
- Can be neglected if the BBB is intact



Disrupted BBB: False decreased Perfusion Values

- T1- and T2*-effect are antagonistic
- Pure T2*-effect that determines CBV cannot be measured

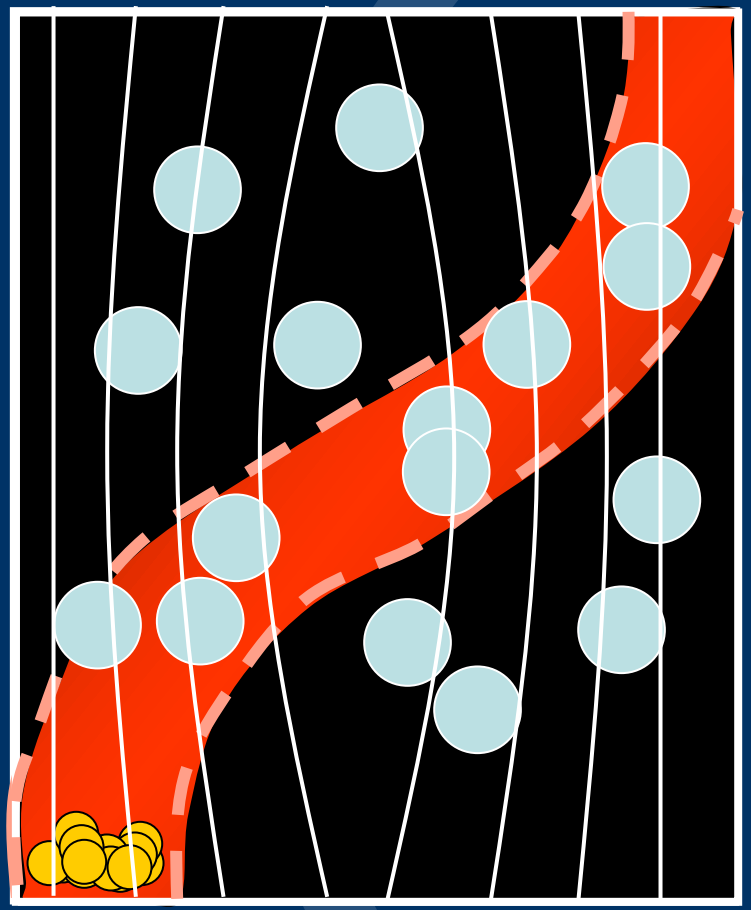
- **Underestimation of CBV**



Correction technique: Preload

Most common:

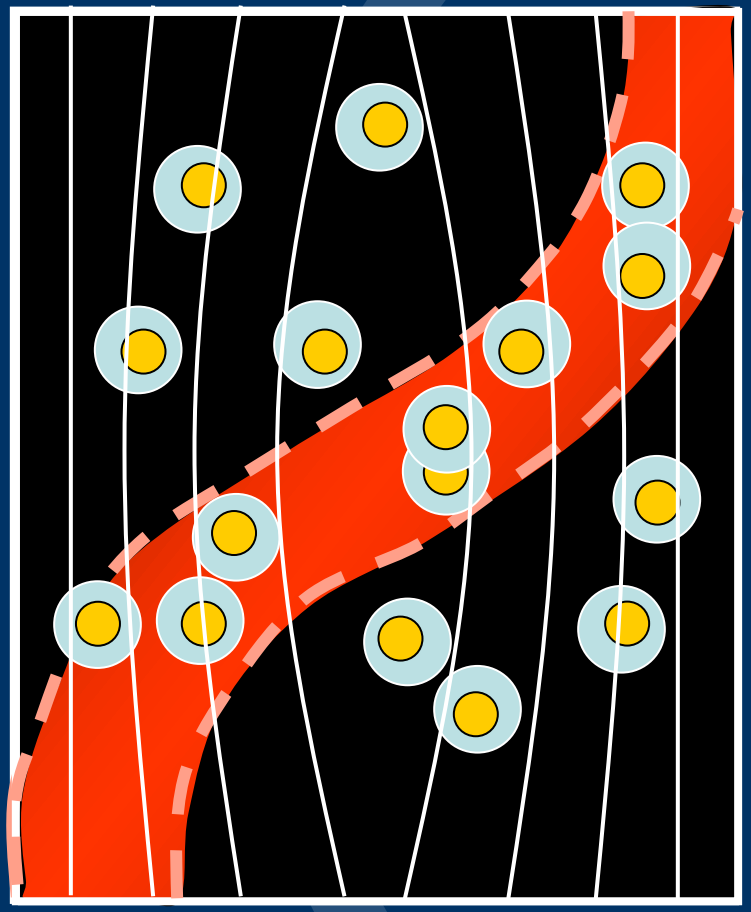
Preload of contrast agent 5 minutes prior to DSC-Perfusion



Correction technique: Preload

After drainage of contrast agent:

Interstitium is pre-saturated!

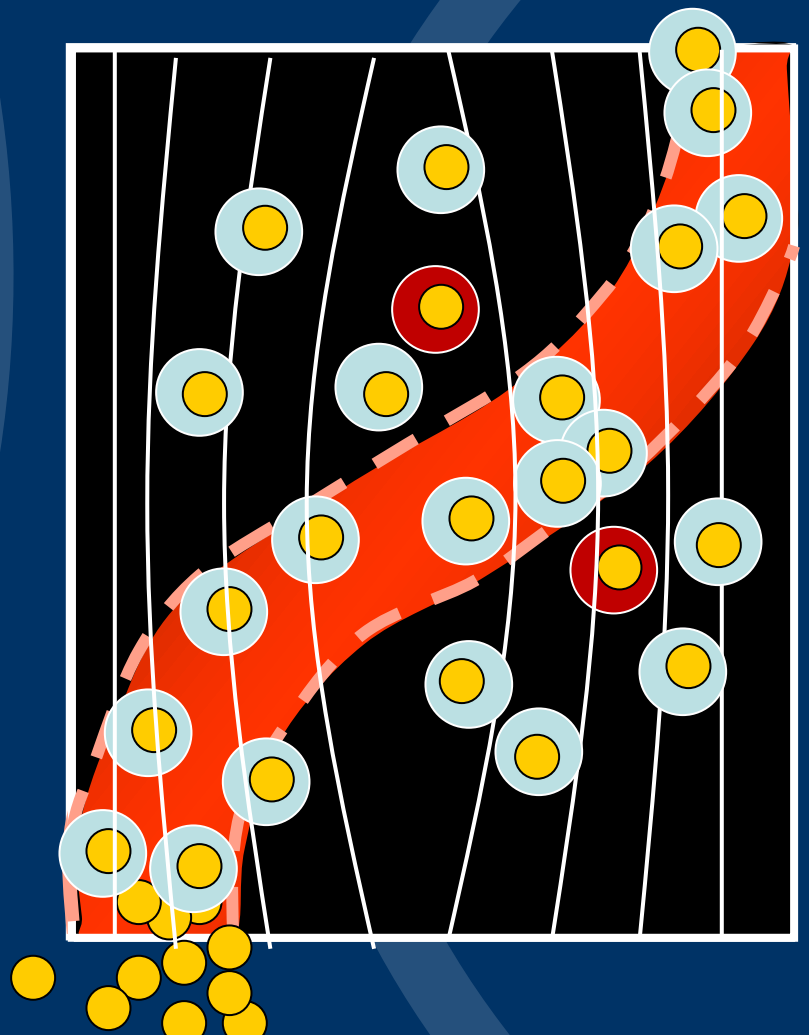


Correction technique: Preload

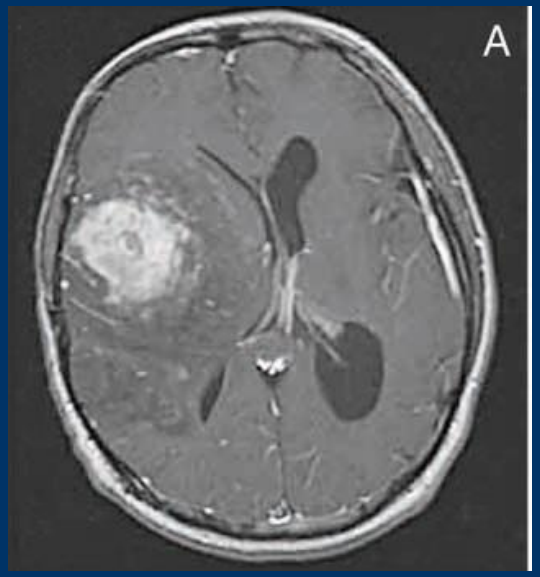
After 5 minutes: DSC-Perfusion

Reduced drainage of contrast agent in interstitium

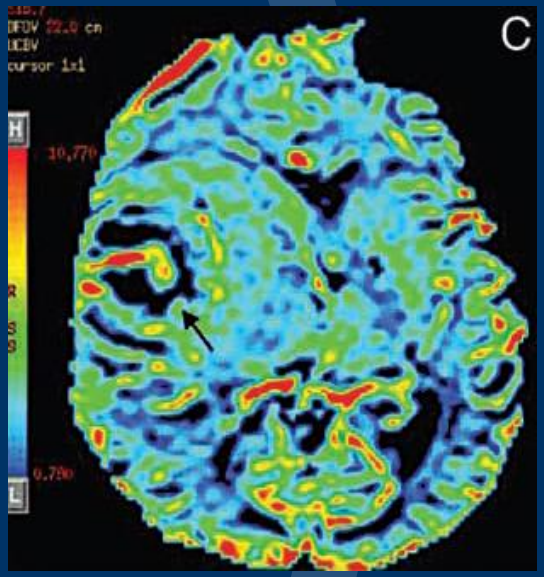
Measurement of pure T2*-effect



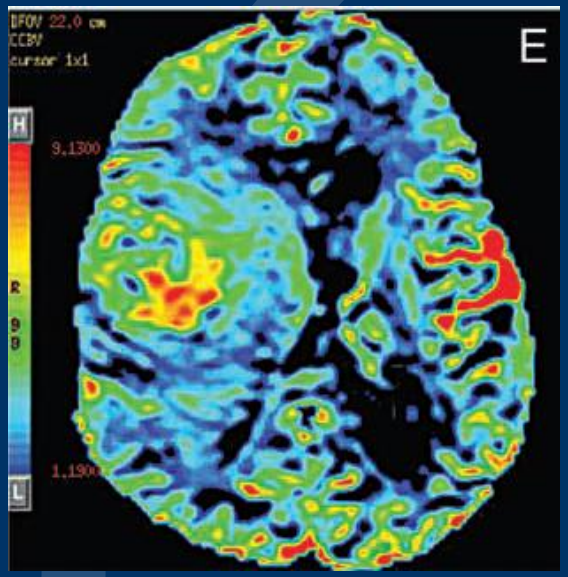
Underestimation of CBV



ce-T1



Without correction techniques



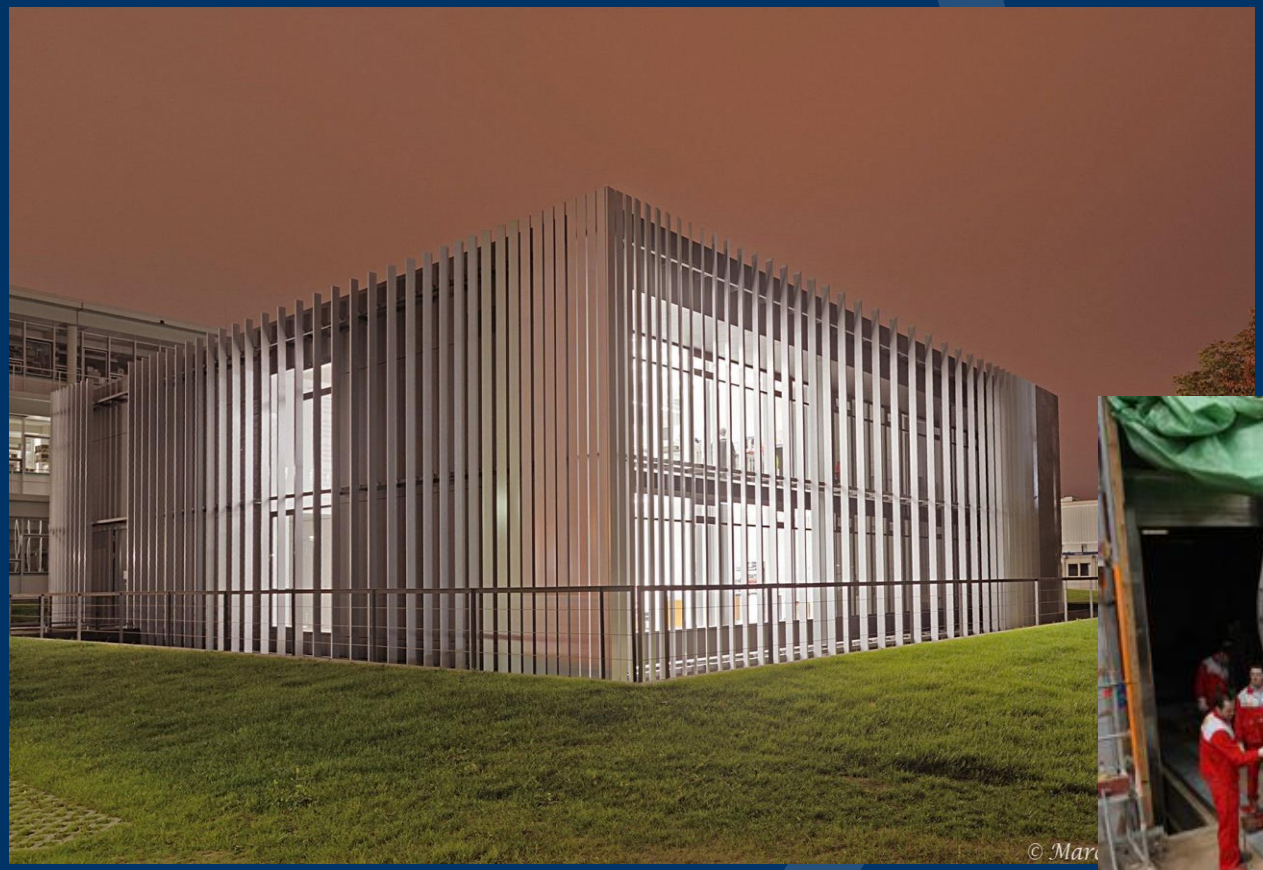
With correction technique

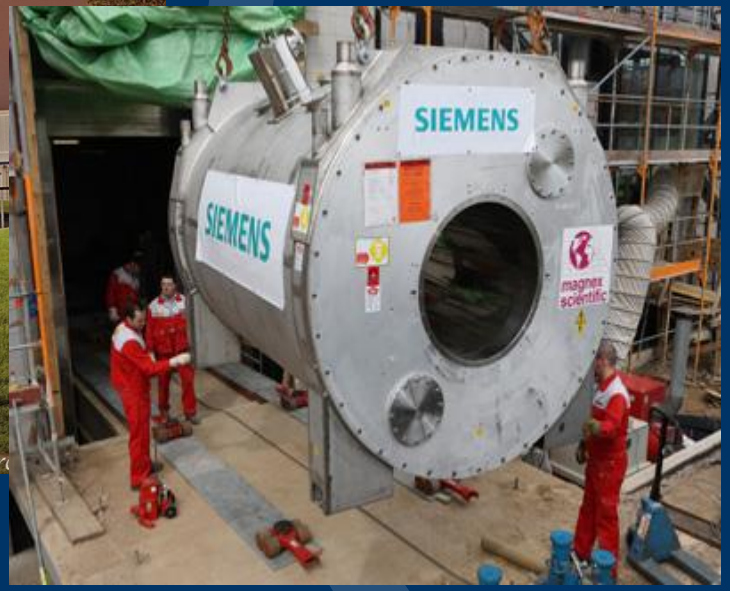
Urgently needed: Standardization of MRI techniques within different centers and in clinical trials

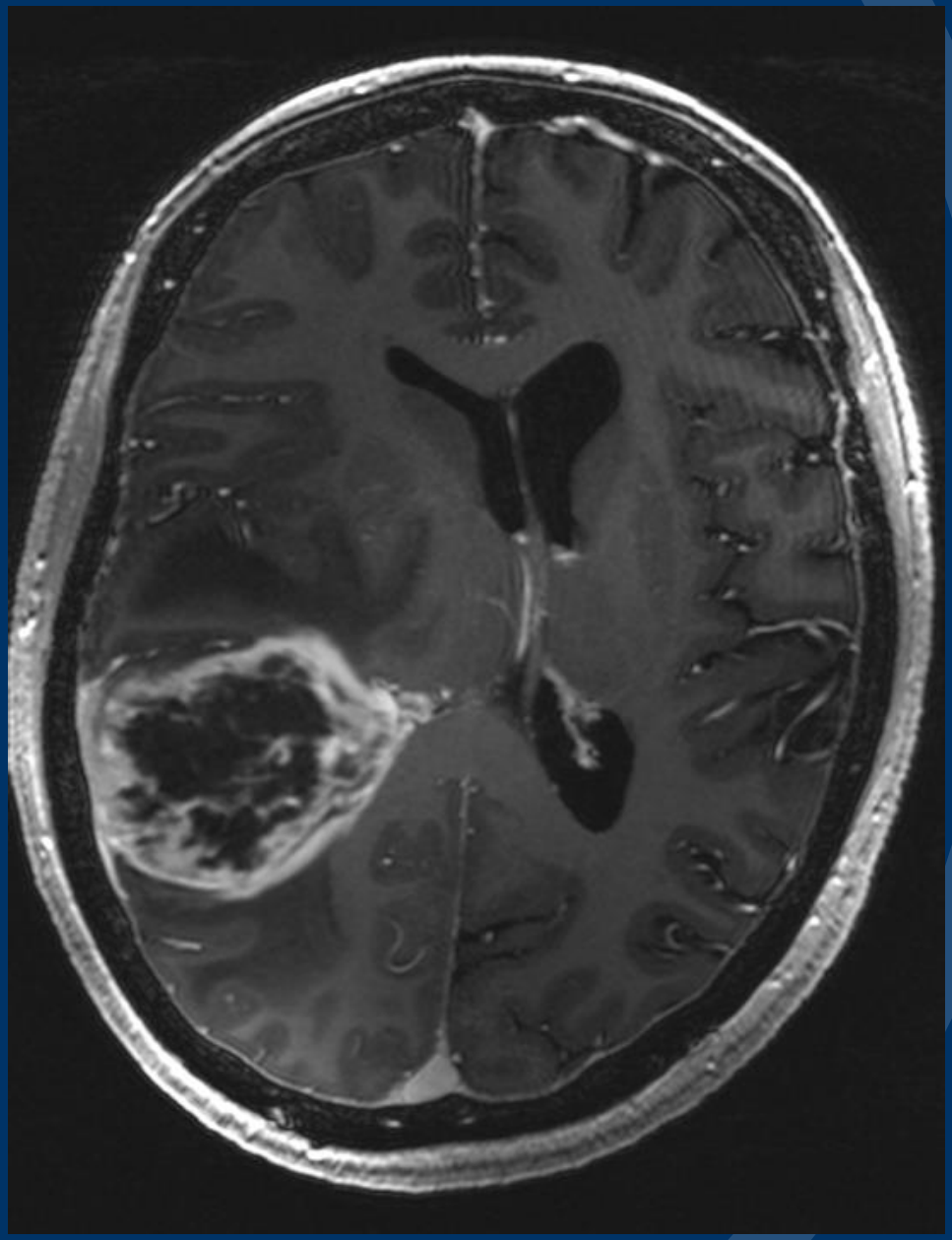
Covarrubias et al; The Oncologist 2004;9:528-537 “Dynamic Magnetic Resonance Perfusion Imaging of Brain Tumors”

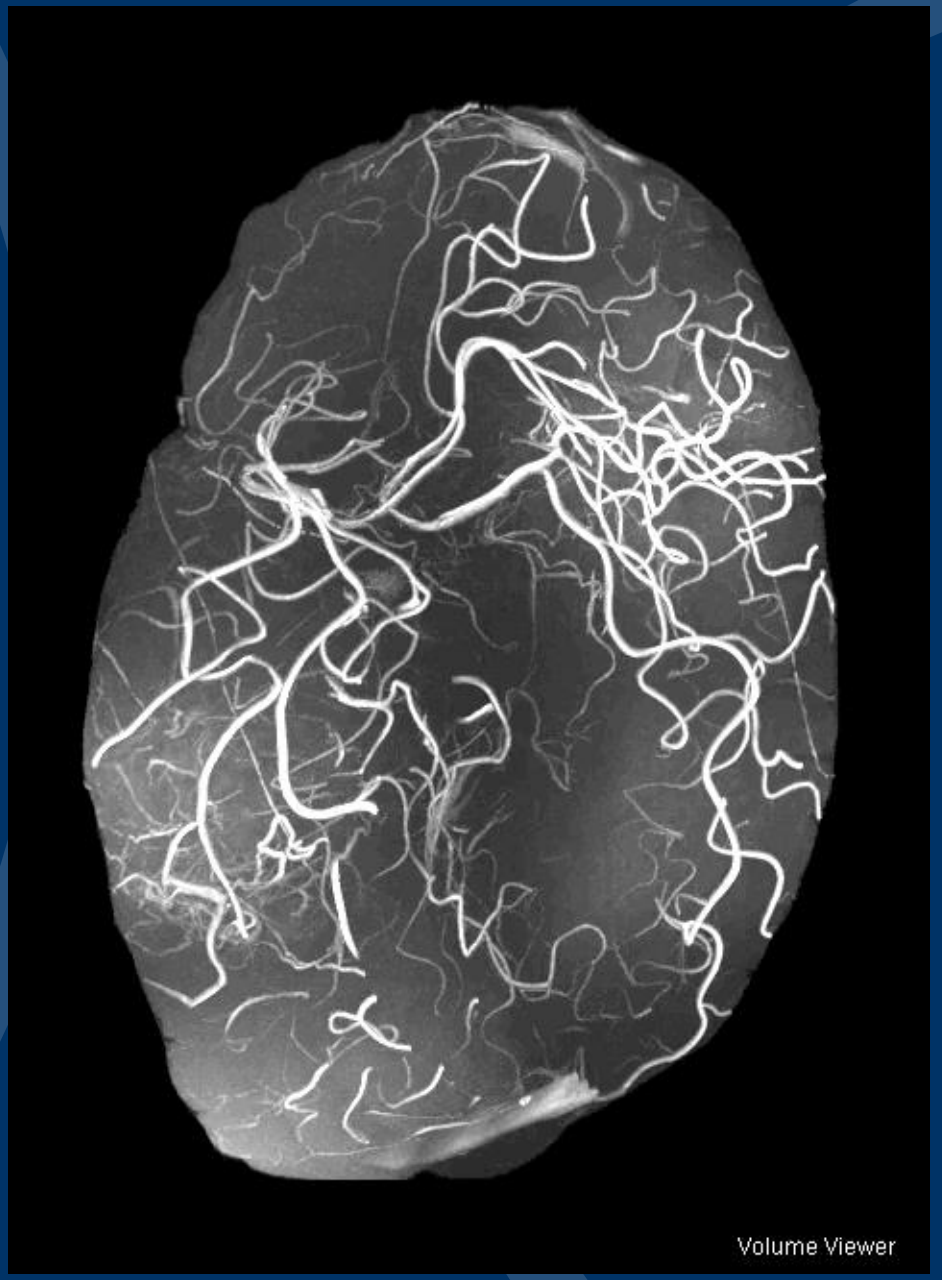

What is on the horizon?

Ultra-High-Field: 7 Tesla



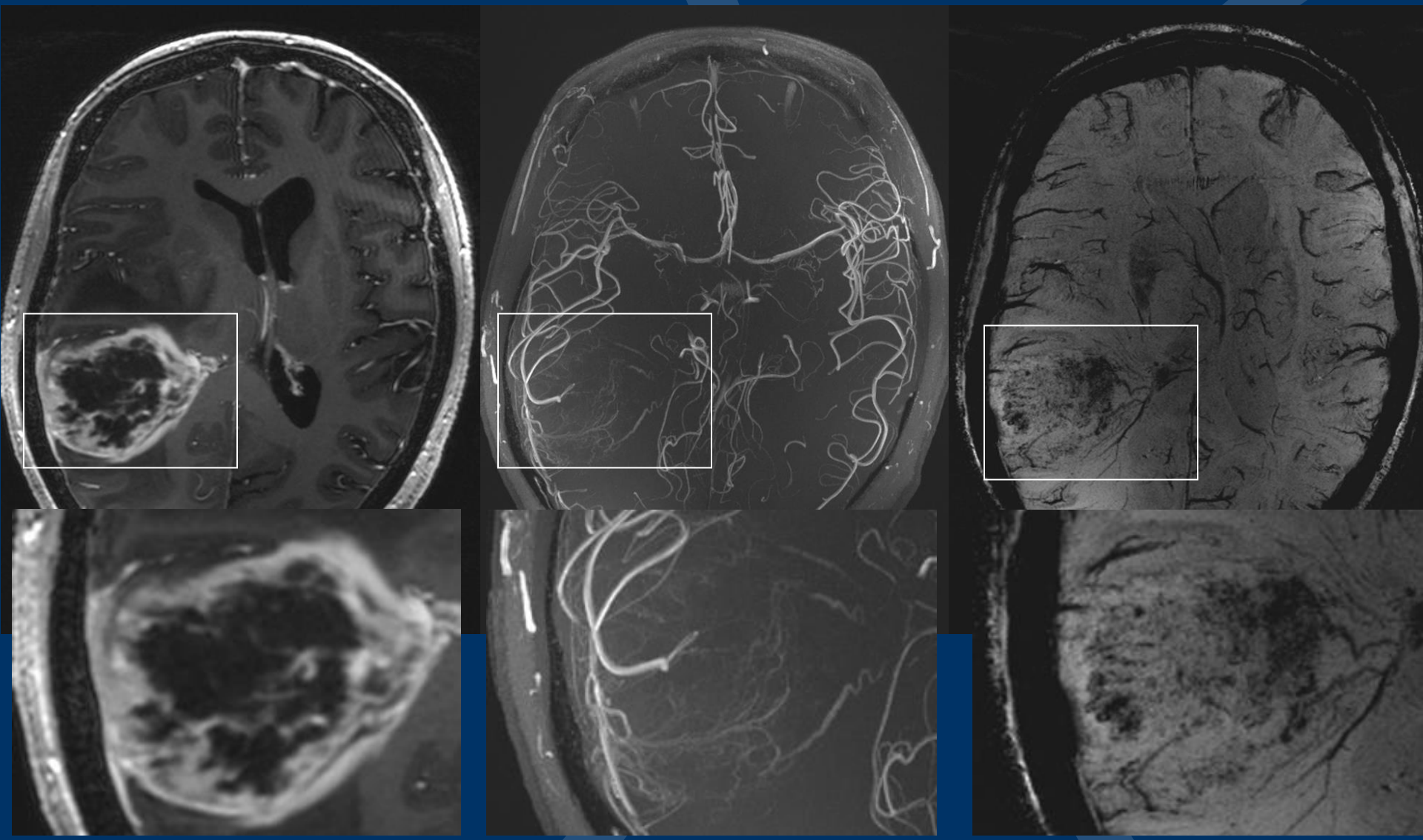


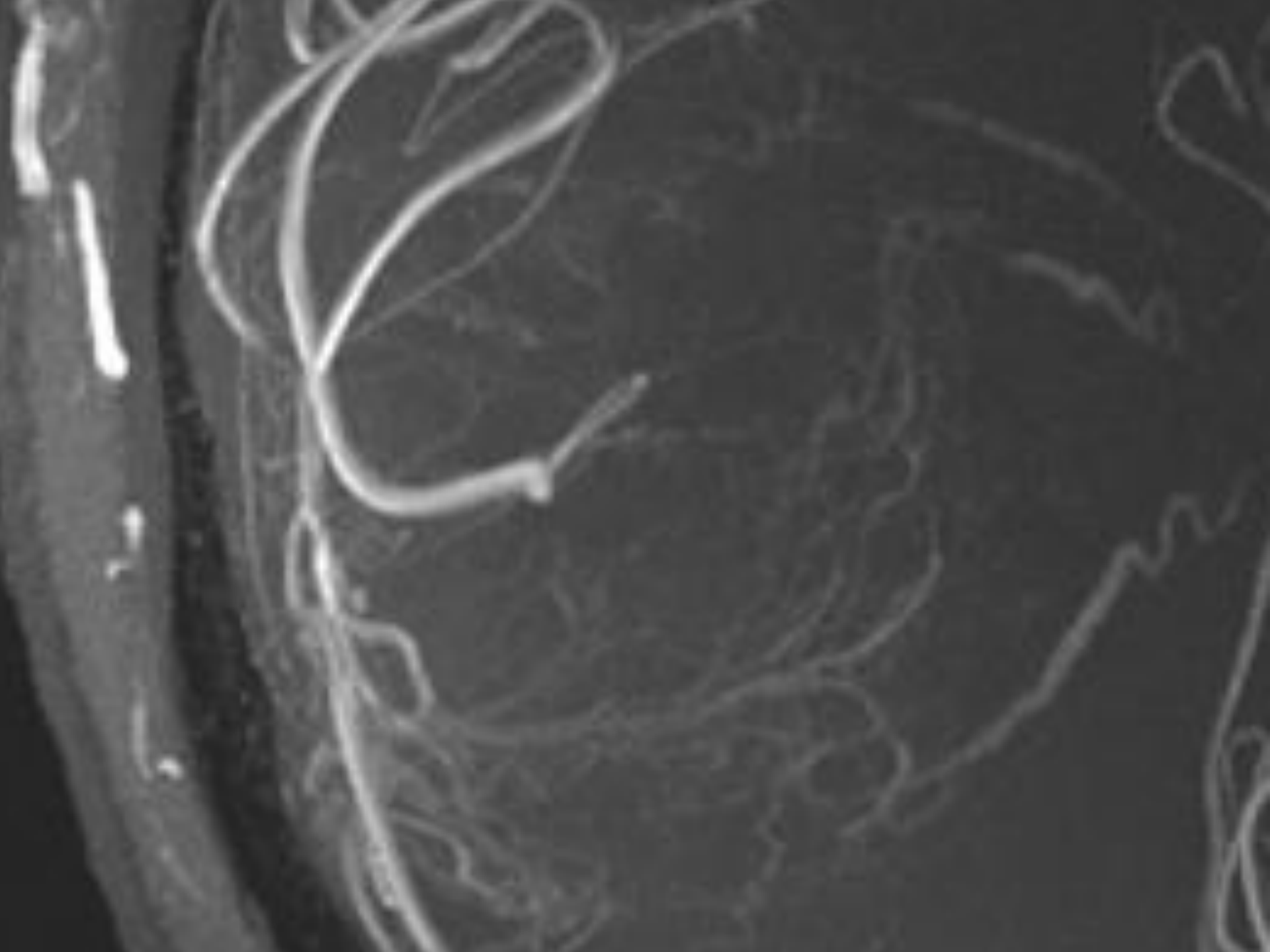



Volume Viewer

Thank you for your attention!

7 Tesla






Thank you for your attention!