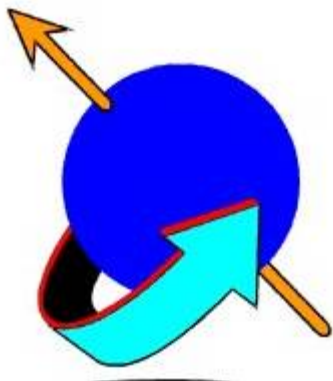


MR mozgových nádorov - z hľadiska rádioterapie

V. Belan,
Dr. Magnet Kramáre
Bratislava



Mozgové nádory

MR

- detekcia
- pred op – charakterizácia, planovanie op. výkonu
- po op (do 72 hod, 3-6 mes)
- sledovanie – bez op., po op.- reziduum

- plánovanie SRS
- sledovanie po SRS - regresia, progresia, stabilita, postradiačné zmeny

MR a mozgové nádory

- *cMR(konvenčné)- štrukturálne informácie*
- rozšírené MR (advanced MRI, multimodality MRI, BG BT protokol) – komplementárne info

- *identifikácia okrajov*
- *grading TU*
- *redukcia chirurgického rizika*
- *posúdenie odpovede na Th*

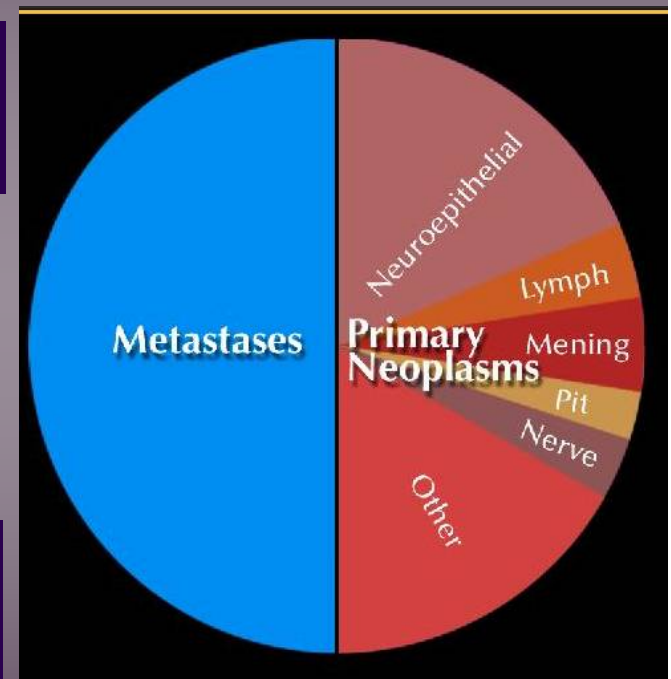
Klasifikácia mozgových nádorov

- Primárne
- Sekundárne (MTS)

- intraaxiálne – z mozgového parenchýmu
- extraaxiálne – z tkanív obklopujúcich mozog

Regionálna klasifikácia:

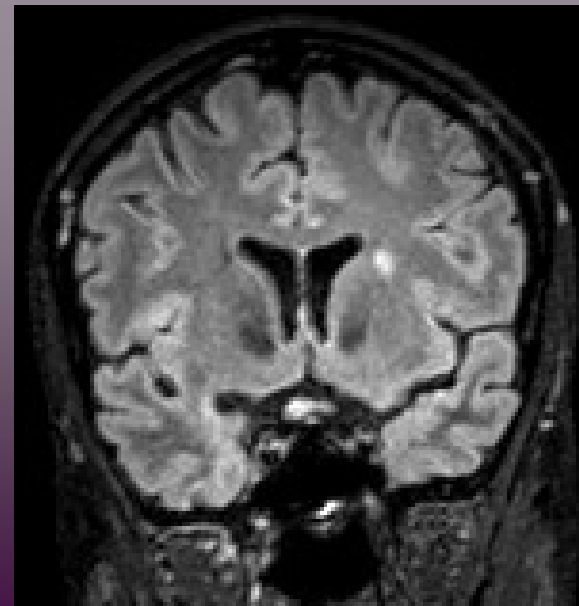
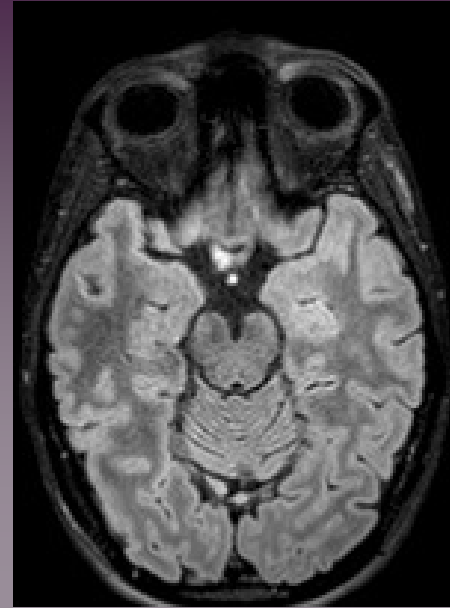
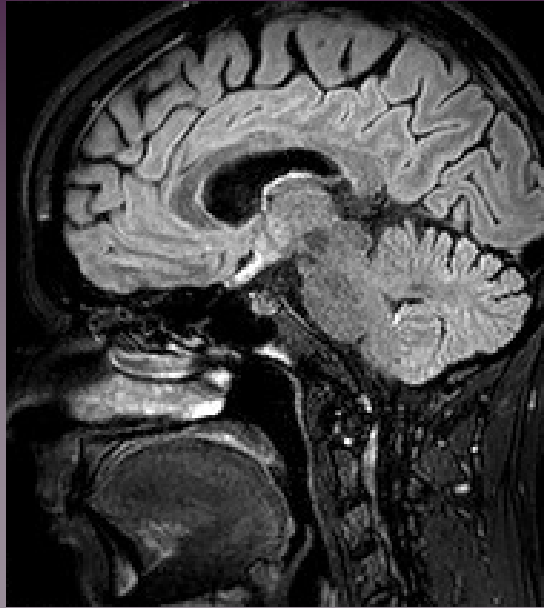
- supratentoriálne
- infratentoriálne



3D FLAIR (Fluid attenuation inversion recovery)

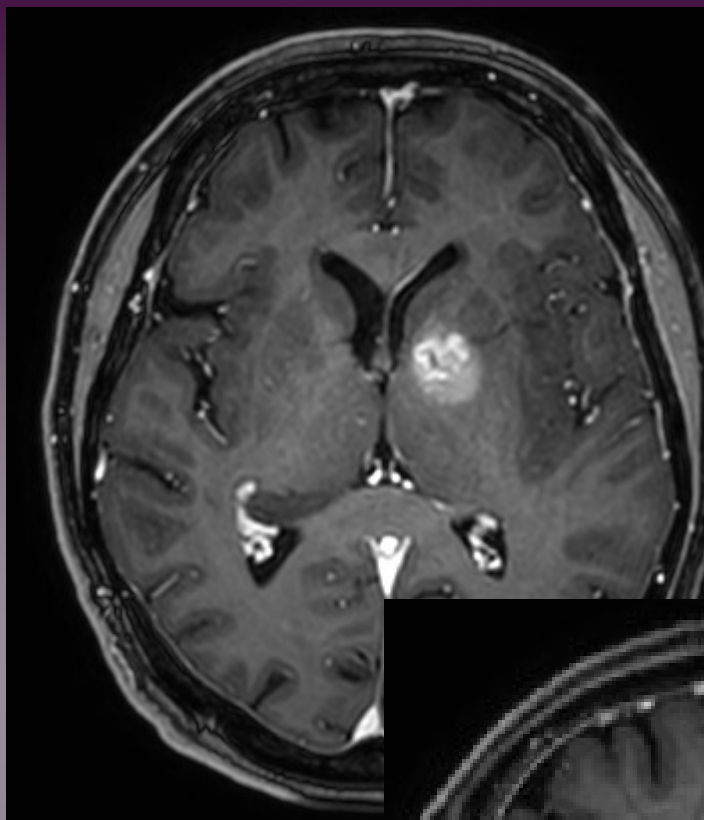
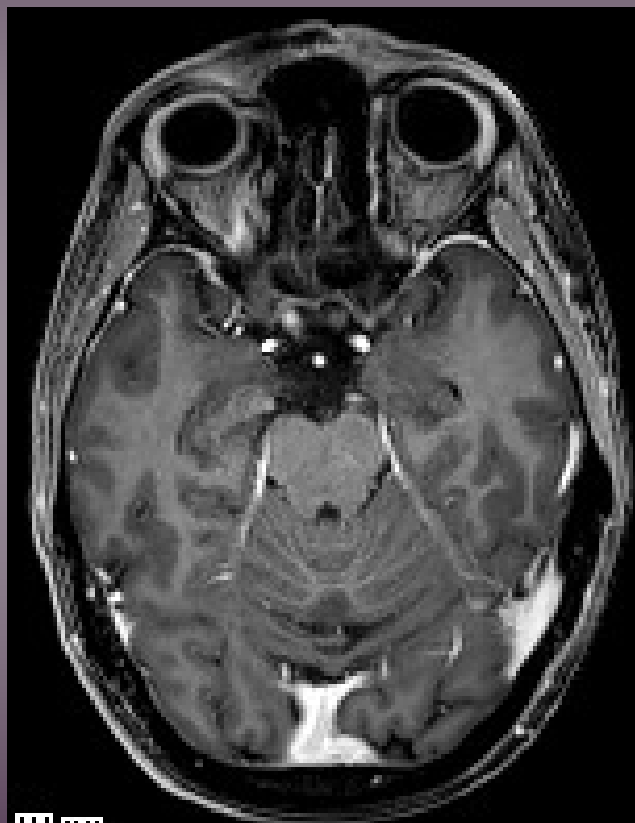
- 1 mm izotropné zobrazenie
- lepšia kontrastná rezolúcia v porovnaní s konv. PD a T2 ako i štand. FLAIR
- sledovanie - izotropná MPR- porovnanie + zvýšená senzitivita nových lézií

3T Ingenia - 3D FLAIR

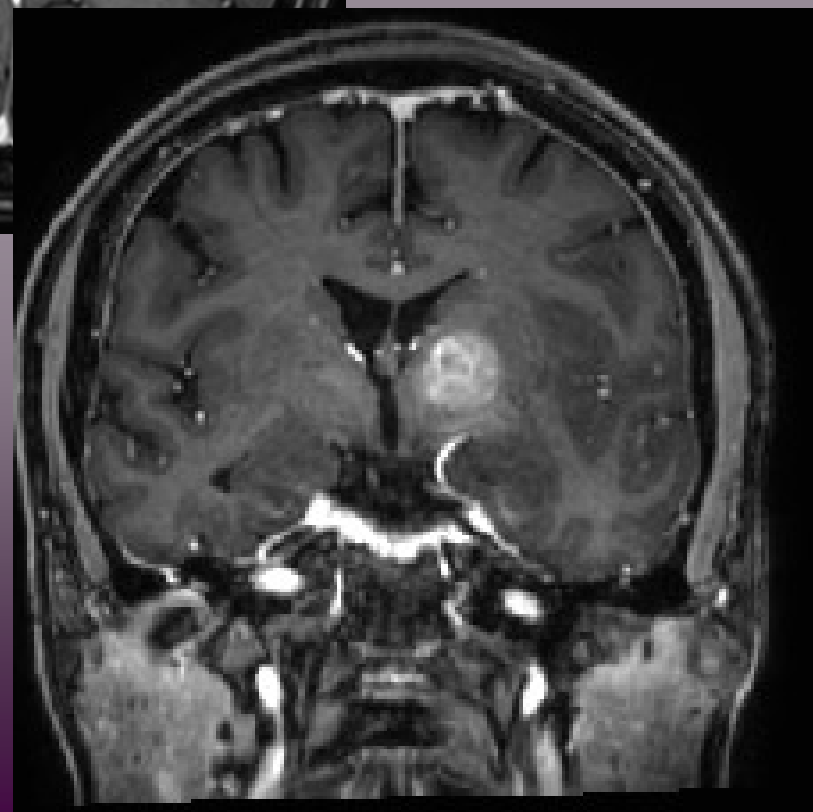


3D T1 MPRAGE

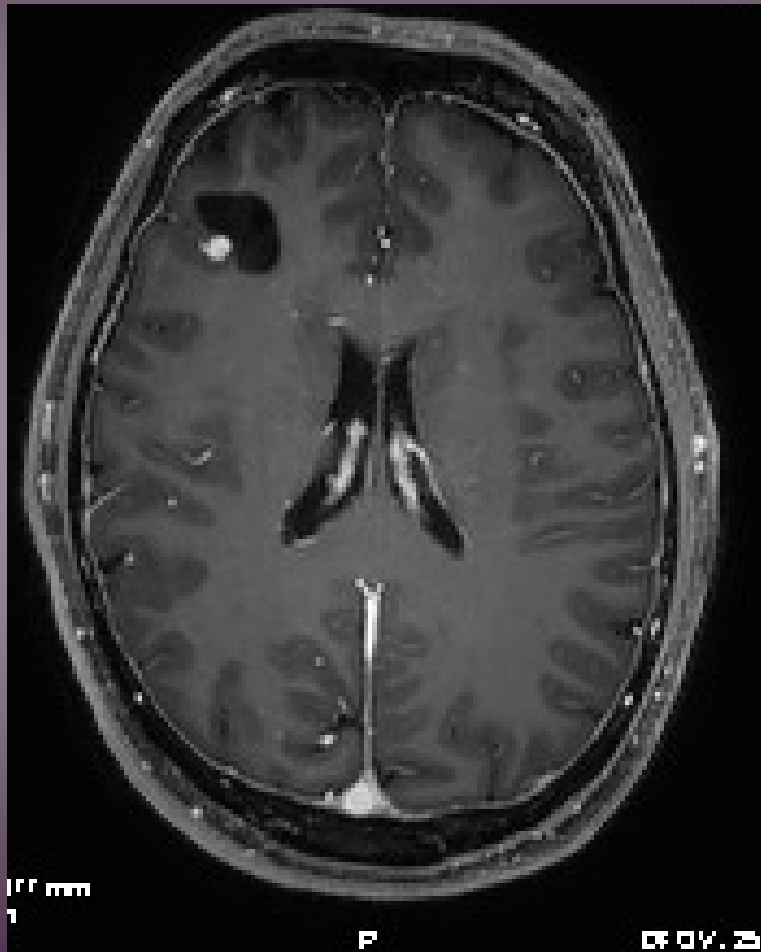
- MPRAGE (magnetization-prepared rapid gradient-echo)
 - 1 mm izotropné zobrazenie
- senzitivita zobrazenia malých sýtiacich sa ložísk
 - axonálna deštrukcia – „dark holes“



MPR



Hemangioblastóm



Gd_3D T1



SWIp

MR a mozgové nádory

rozšírené MR (advanced)

- *DVO – marker celularity*
- *DTI – integrita traktov v BH*
- *PMR- marker TU vaskularity a angiogenézy*
- *MRS – TU metabolizme*
- *fMR – identifikácia eloquentnej kôry*

Difúzne VO (DWI a ADC)

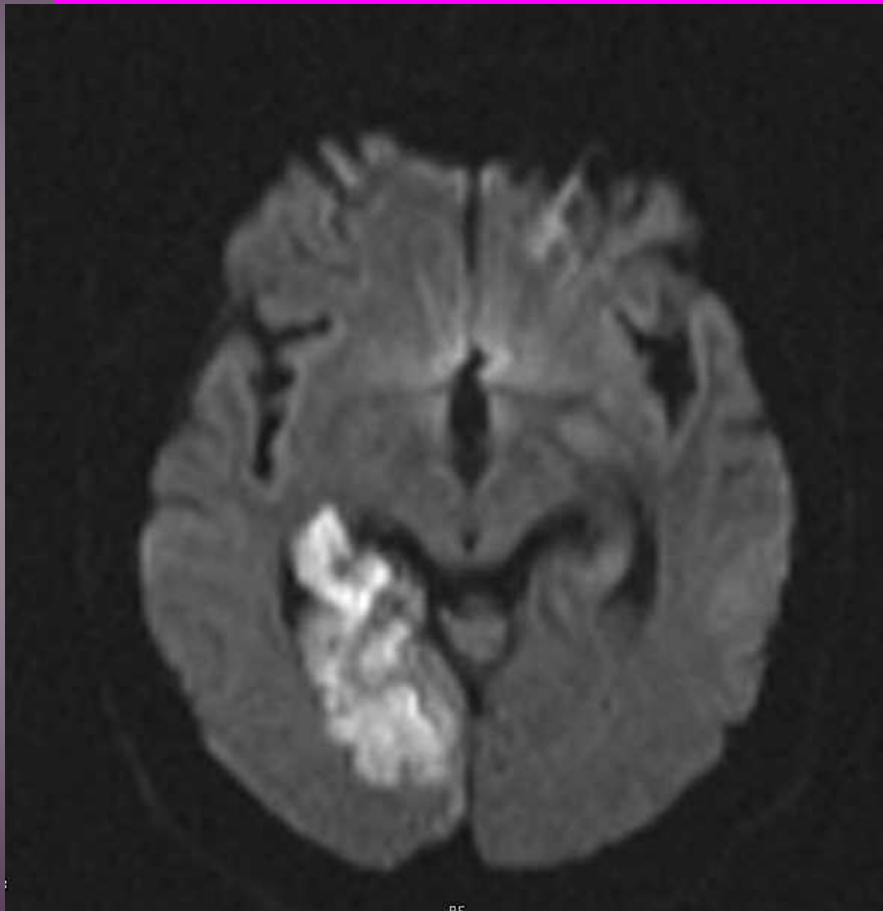
DWI - EPI - b0, b500, b1000

- hypersignál - 1. znížená difúzia, zvýš. celularita a denzita proteinov
- 2. celkové množstvo vody - T2 efekt

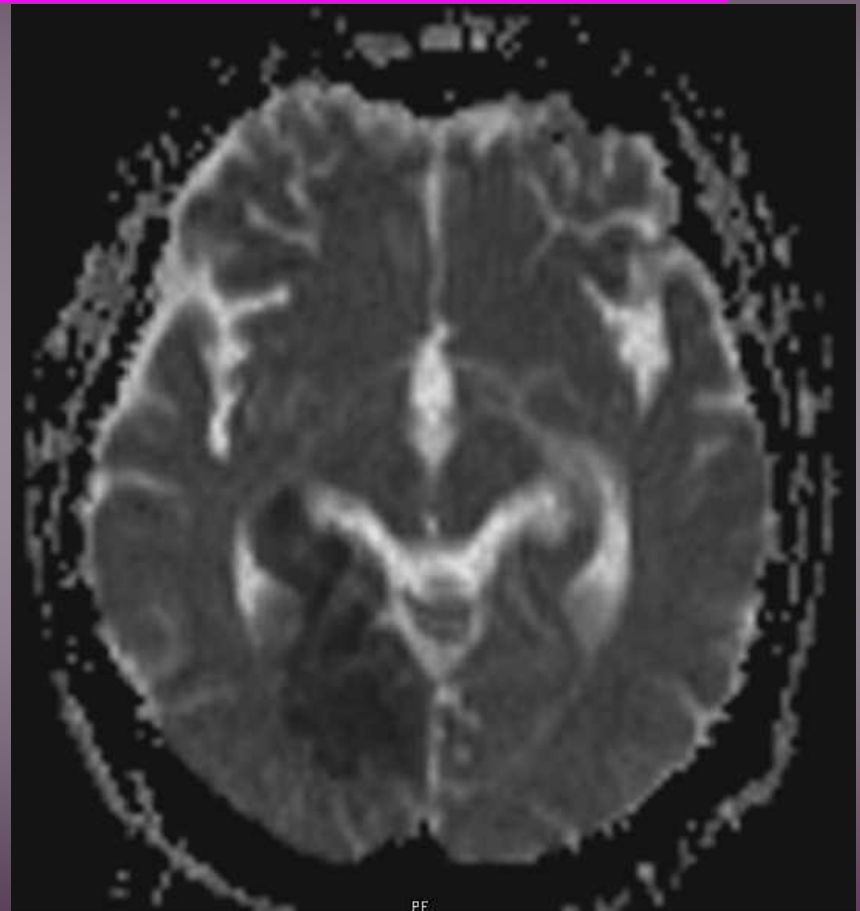
ADC - apparent diffusion coefficient - bez T2 efektu

- z b0 a b1000
- hyposignál - znížená difúzia

Difúzne VO (DWI a ADC)

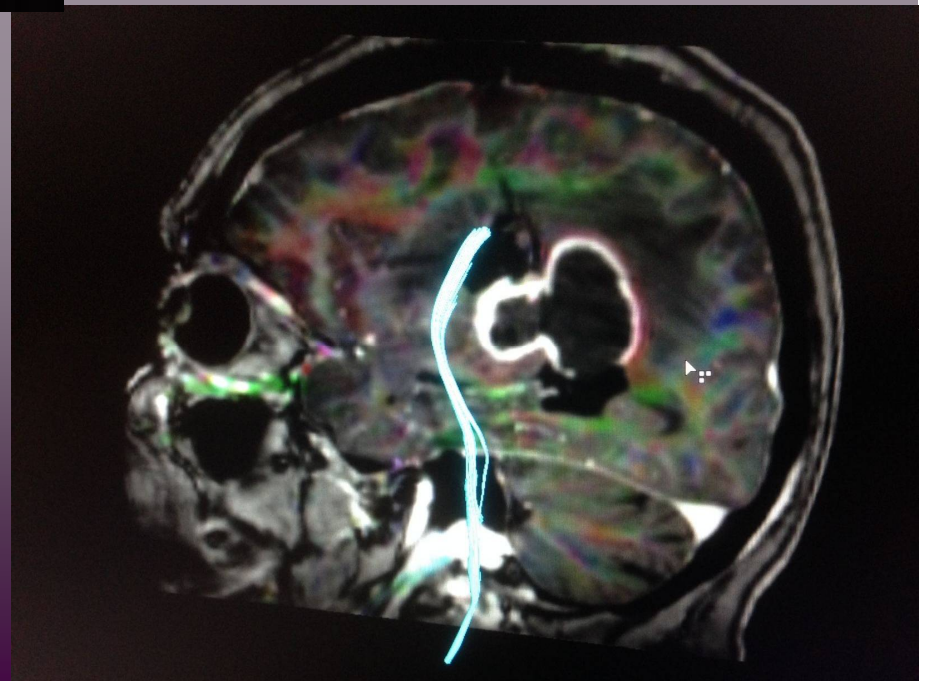
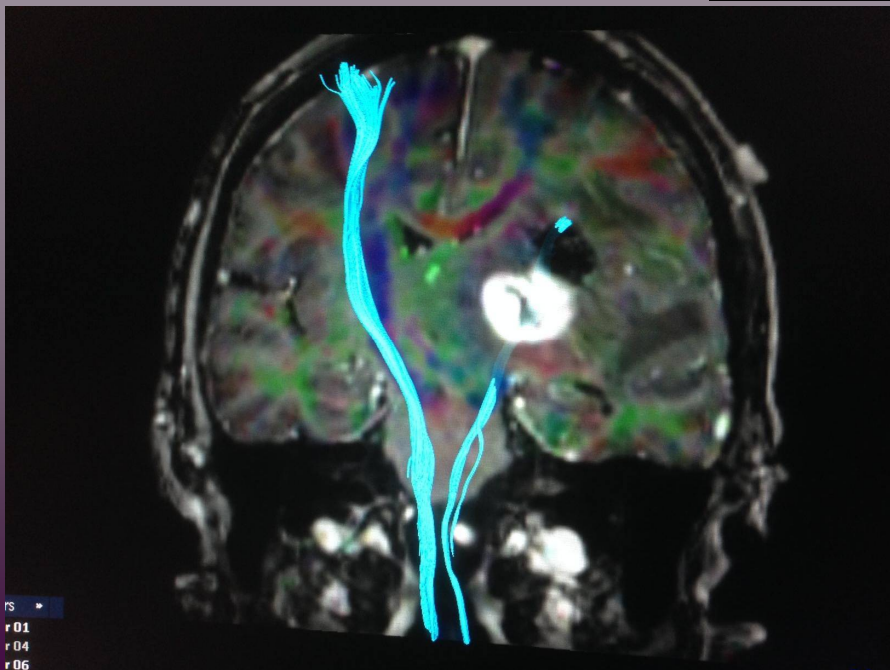


DWI



ADC

DTI – integrity traktov v BH

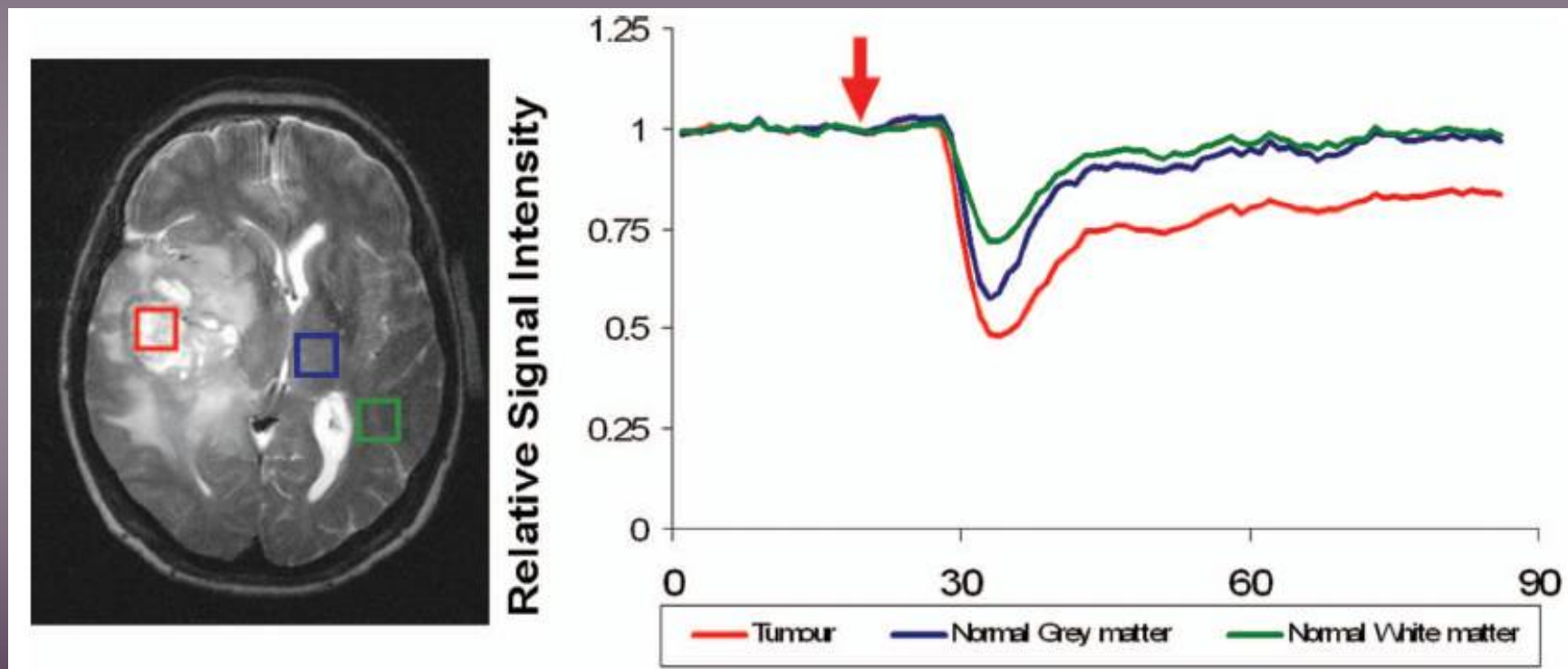


PMR- perfúzne MR

3 MR metódy mozgovej perfúzie

- Dynamic susceptibility contrast imaging (DSCI)
 - najrozšírenejšia metóda
 - $T2^*$ Gd
 - nepriamo koreluje s - koncentráciou k.l.
- vaskularitou
- Dynamic contrast enhancement (DCE)
 - rýchle T1 sekvencie
 - zmeny intenzity po boluse Gd
 - difúzia Gd cez HEB do EES:
 - capillary transfer coefficient (K^{trans})
 - the volume of the EES (v_e)
- Arterial spin labelling (ASL)

Dynamic susceptibility contrast imaging (DSCI)



S. J. PRICE: British Journal of Neurosurgery,
December 2007; 21(6): 562 – 575

Perfúzne MR zobrazenie v mape

- ◆ **CBV (Cerebral Blood Volume)**

merný objem krvi vo vybranej oblasti [ml/100g]

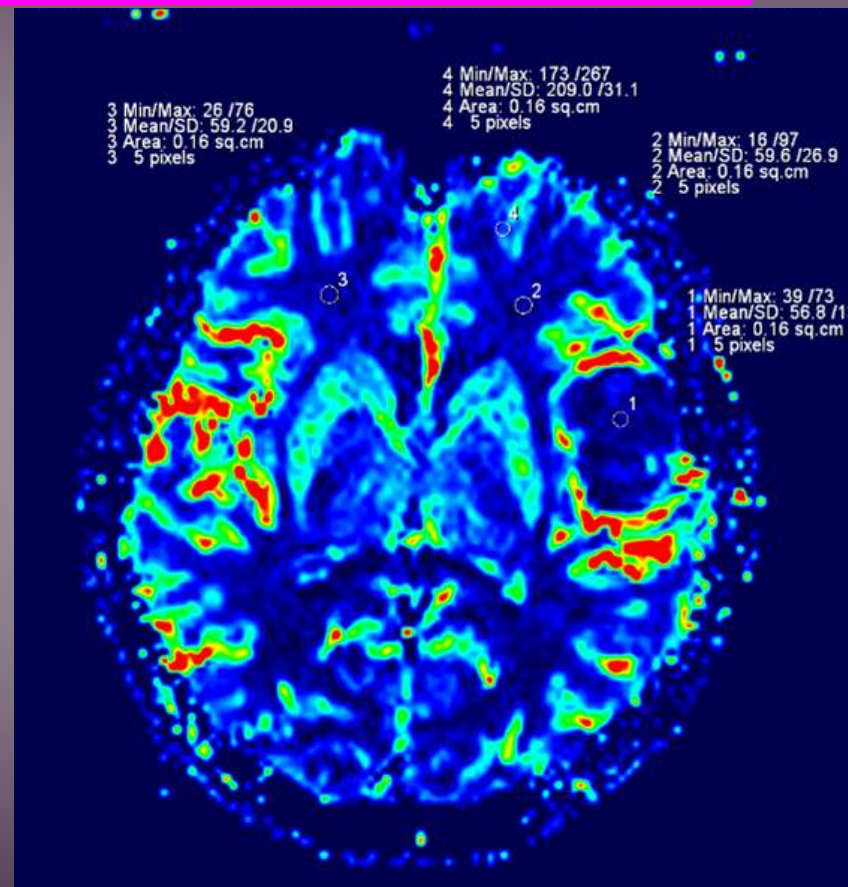
- ◆ **CBF (Cerebral Blood Flow)**

prietok krvi mozgom [ml/100g/min]

- ◆ **MTT (Mean Transit Time)**

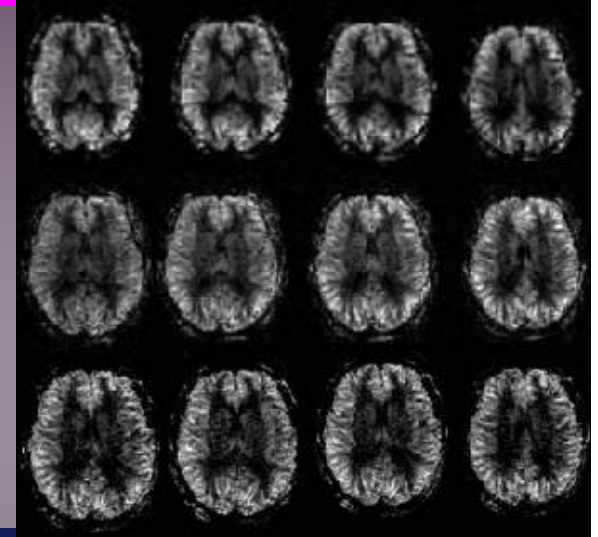
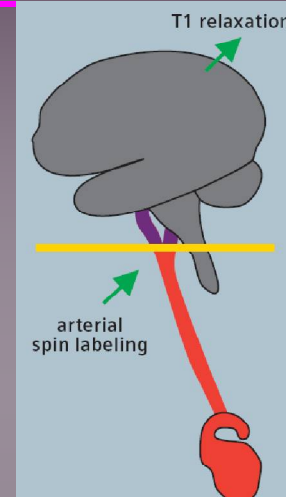
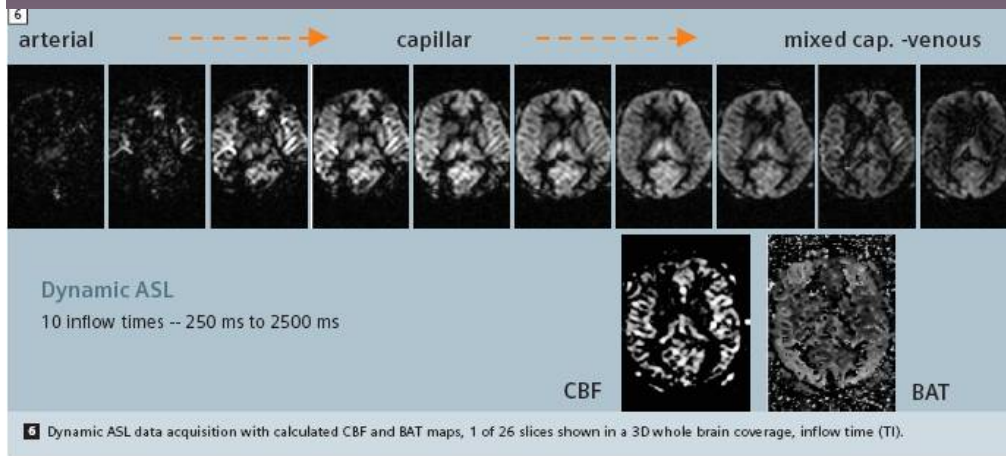
priemerný čas prechodu k.l. (CBV/CBF)

- ◆ porovnanie perfúzie ložiska so zdravou BH a ŠH (ROI)



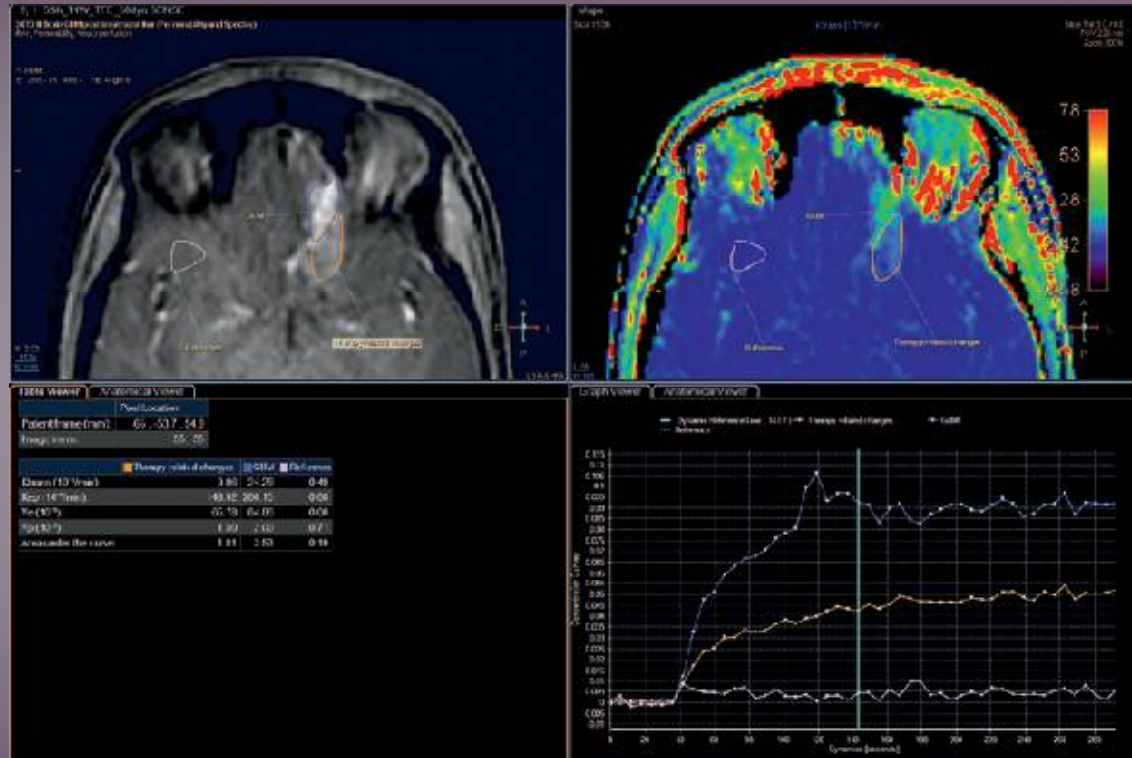
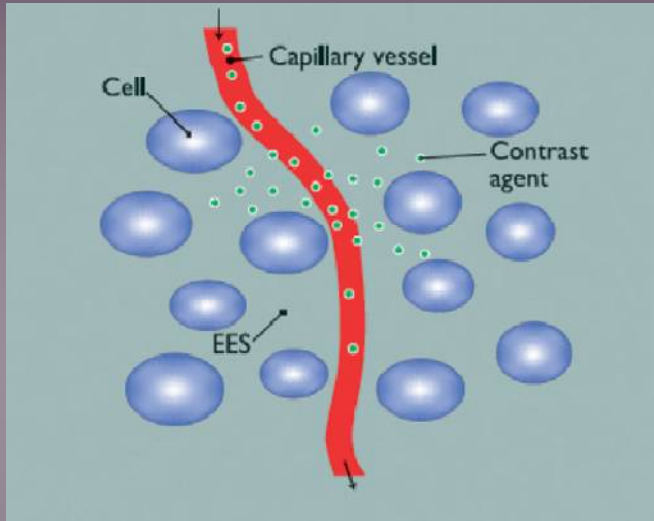
posúdenie angiogenézy a mikrocirkulácie nezávisle od porušenej hematoencefalickej bariery

PMR- Arterial spin labelling (ASL)



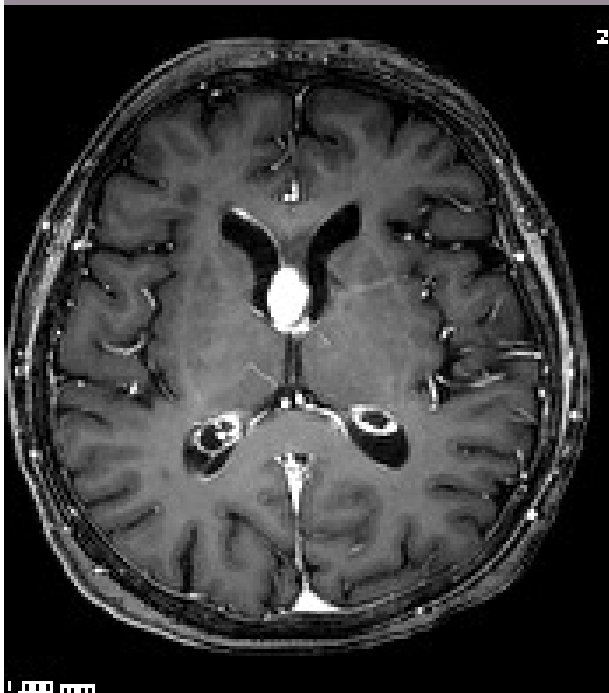
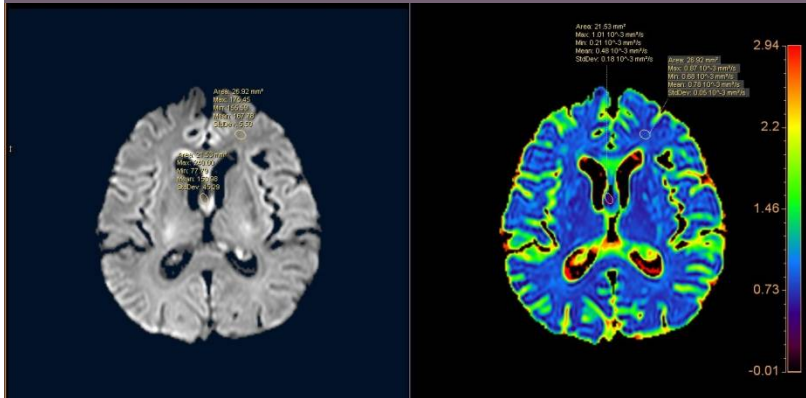
- nová technika
- endogenný kontrastný mechanizmus
 - krv tečúca do mozgu je magneticky značkováaná (arterial spin labelling)
 - subtrakcia dvoch obrazov s rôznym signálom krvi – označenou inverzným RF signálom

PMR- DCE_T1vo MR Permeability



kinetic parameters K_{trans} and K_{ep} .

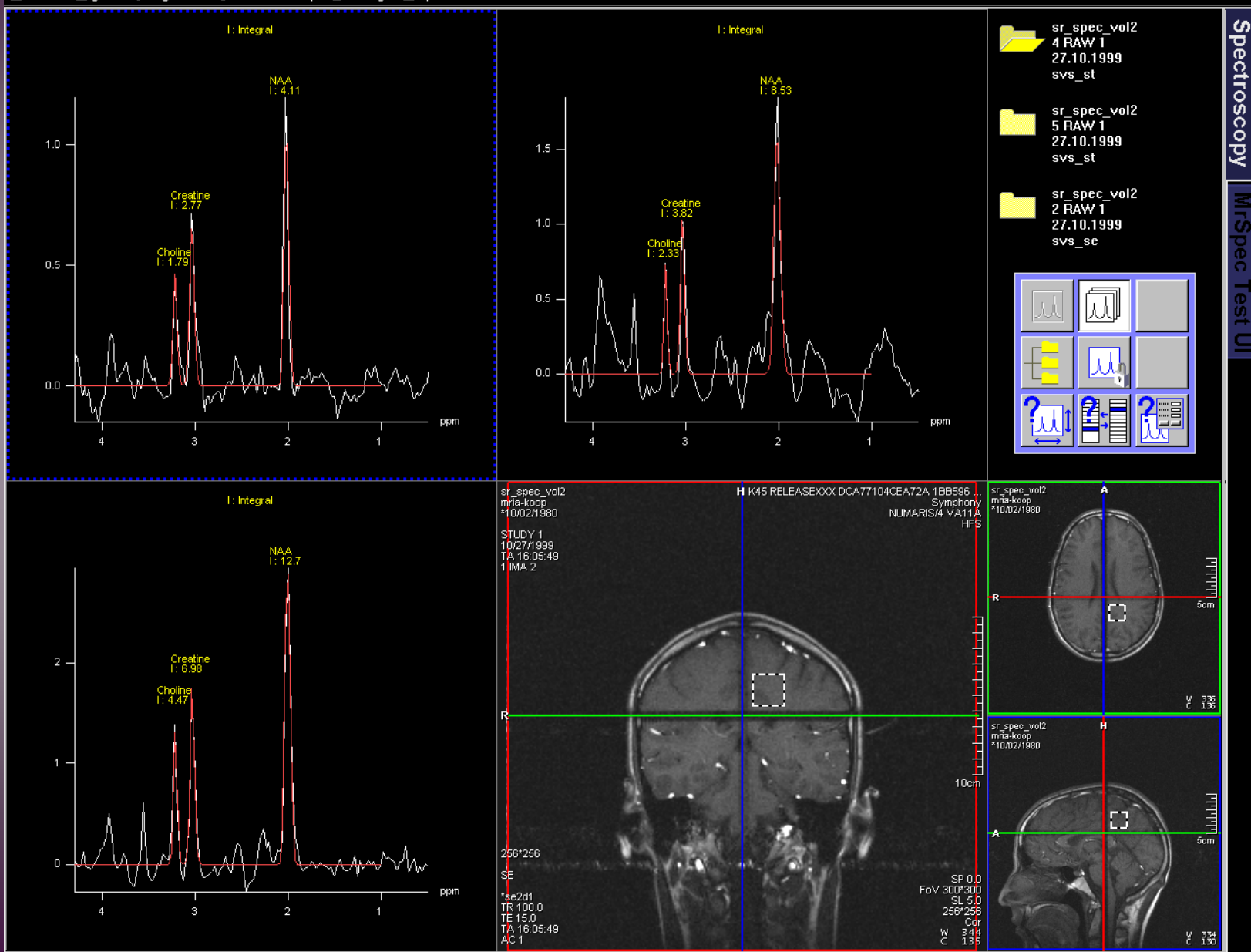
PMR- DCE_T1vo MR Permeability



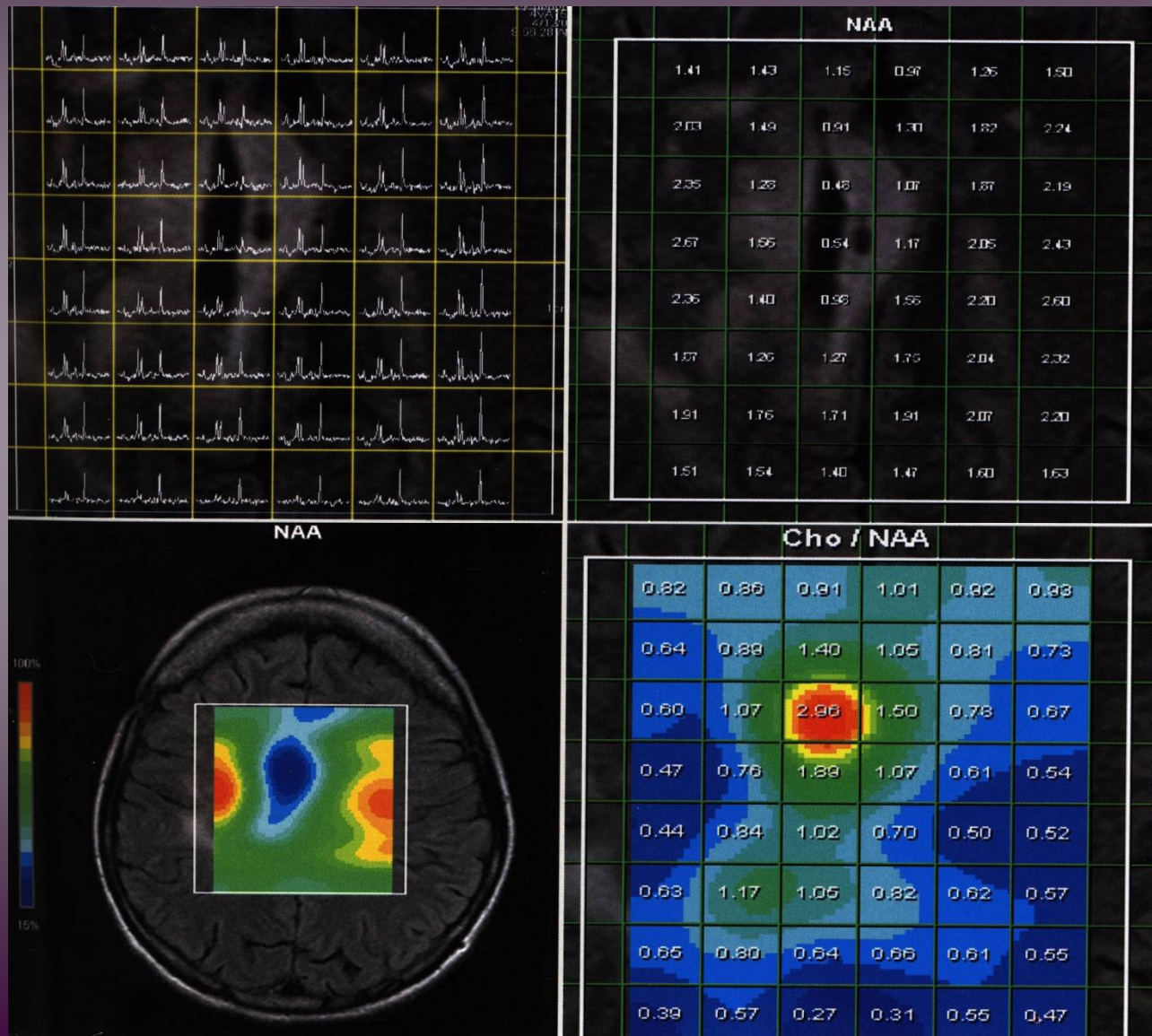
Ktrans

1H-Spectroscopy _ Symphony SVS

Patient Signal Image Protocols Postprocessing Help



^1H -Spectroscopy _ Symphony_CSI



Pozorovatelné metabolity mozgu

Cho (Cholin)

Membránový metabolismus 3,2 ppm

Cr (Kreatín)

Energetický metabolismus 3,0 ppm

NAA (N-acetylaspartát)

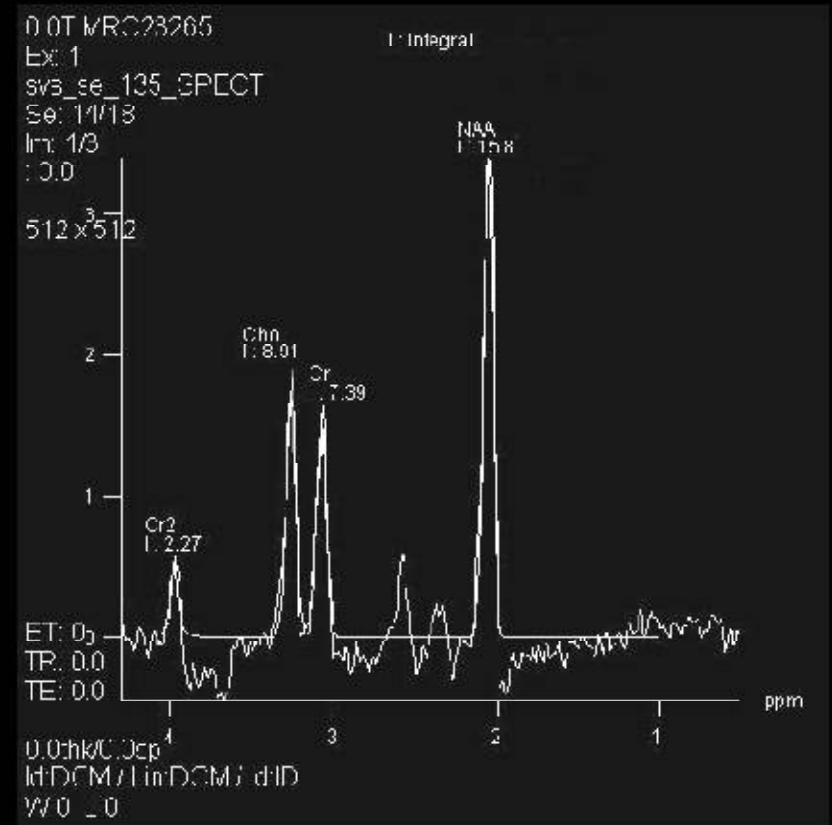
Marker neurónov 2,0 ppm

La (Laktát)

Anaeróbny metabolismus 1,3 ppm

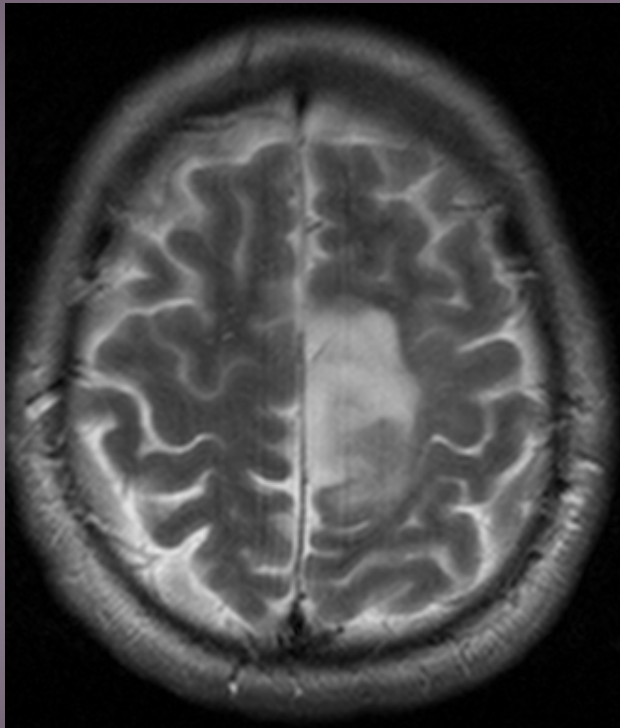
Li (Lipidy)

Nekróza 1,3 až 0,9 ppm

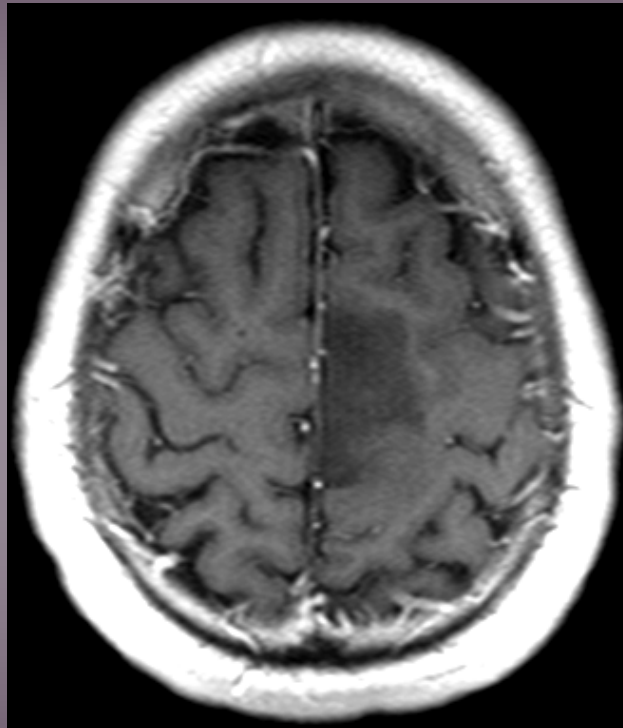


PRESS - TR 1500 TE 135 (8 ml)

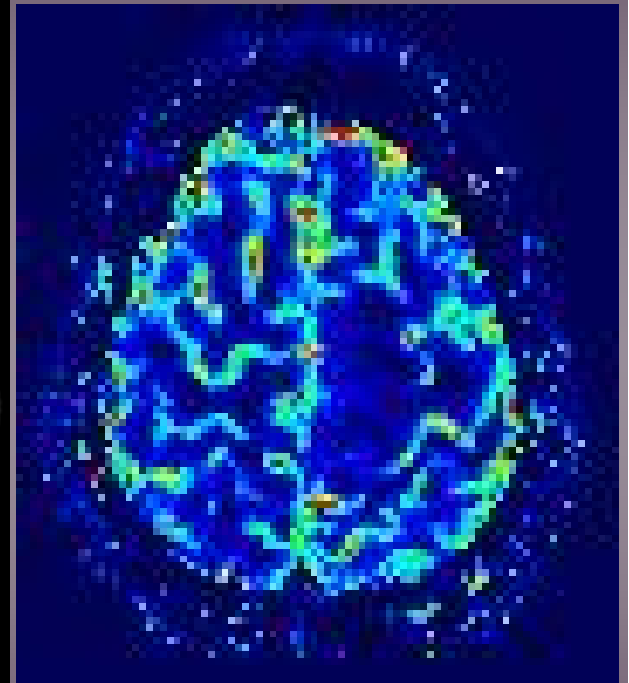
Astrocytóm gr.II



T2

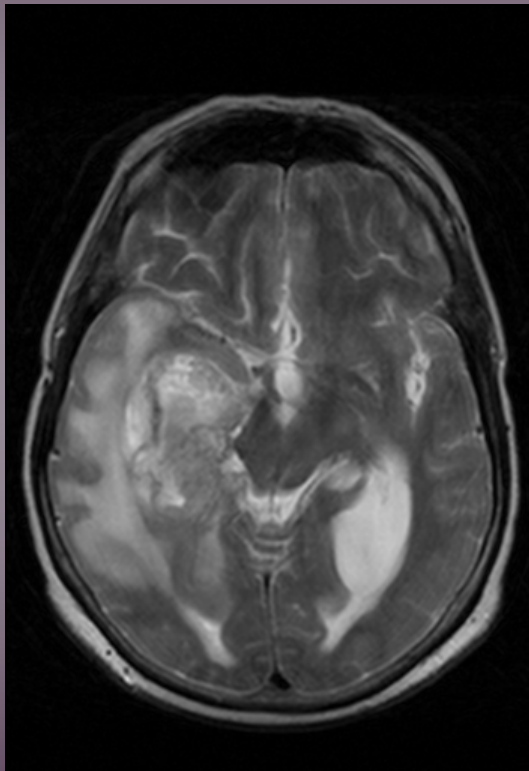


T1 k.l.

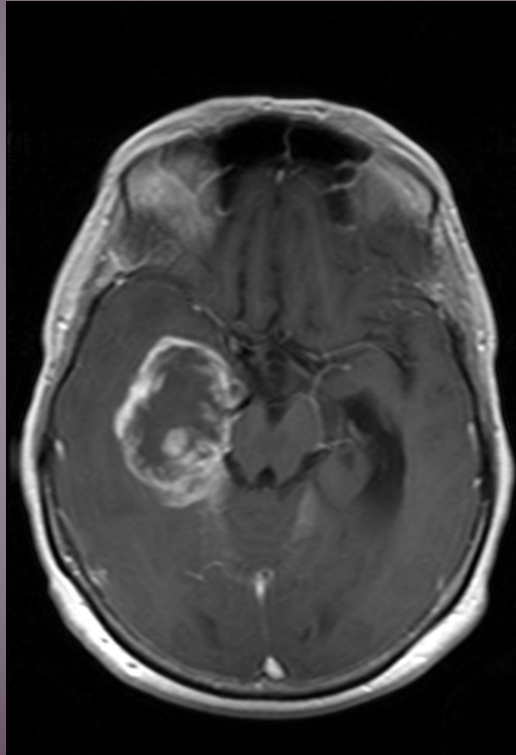


rCBV

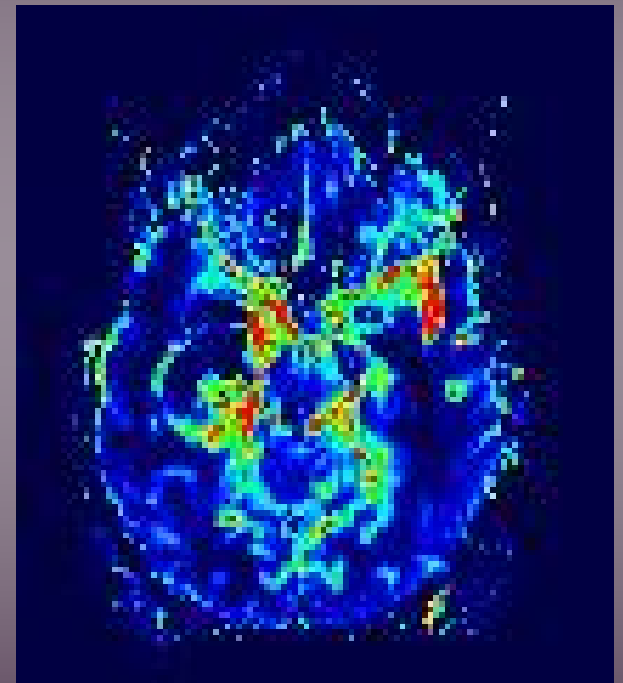
Glioblastóm gr.IV



T2

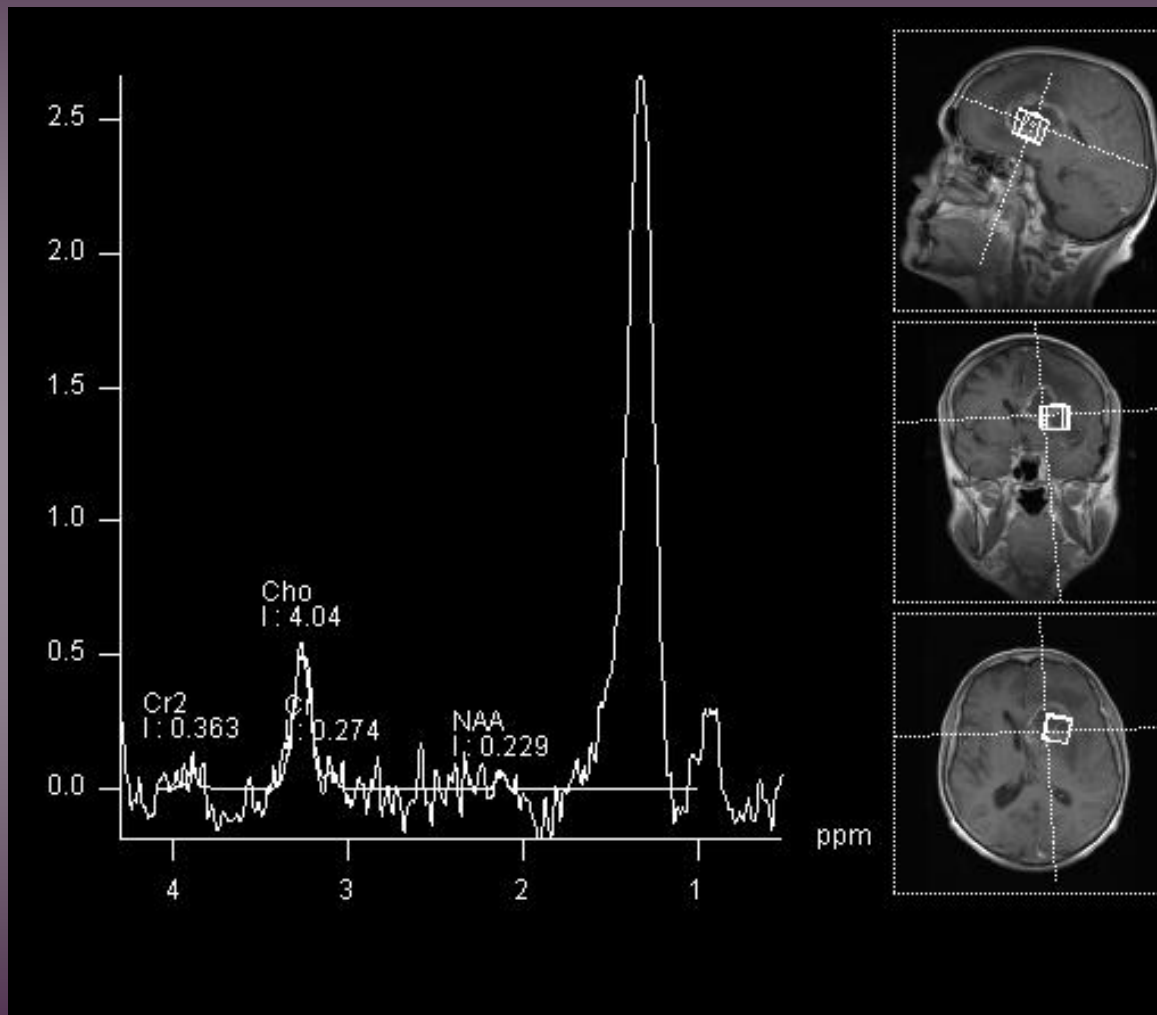


T1 k.l.

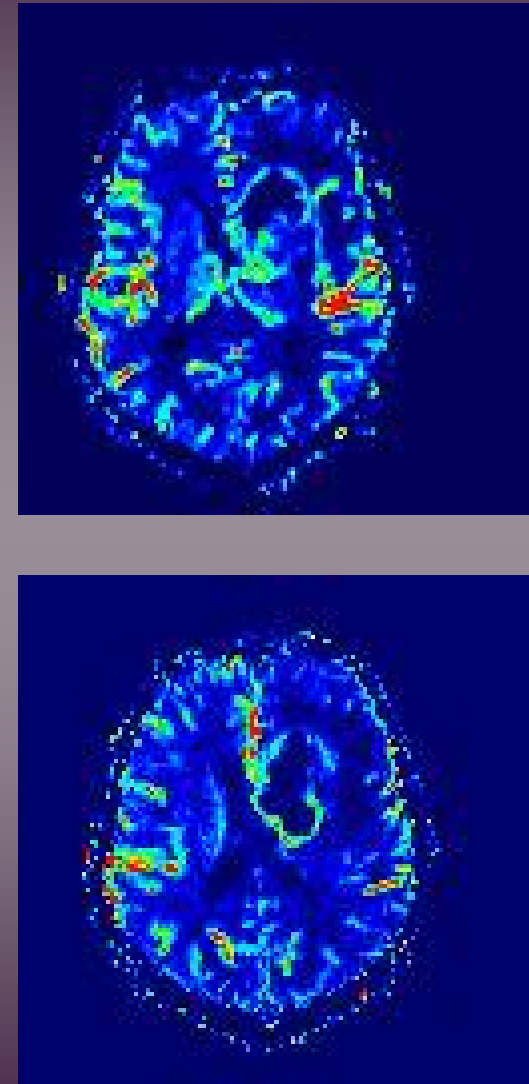


rCBV

glioblastóm Gr.IV

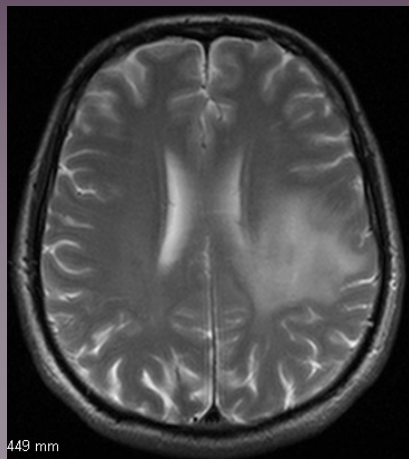


MRS

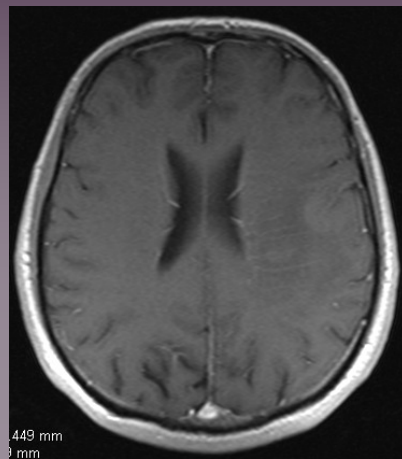


PMR

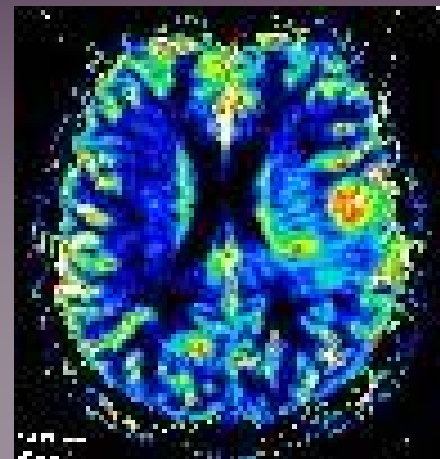
MR 55 r. 30.03.2010



T2vo



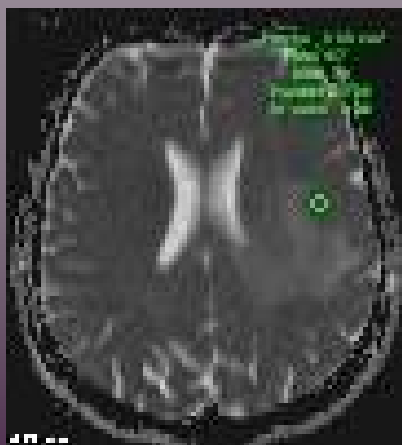
T1vo_Gd



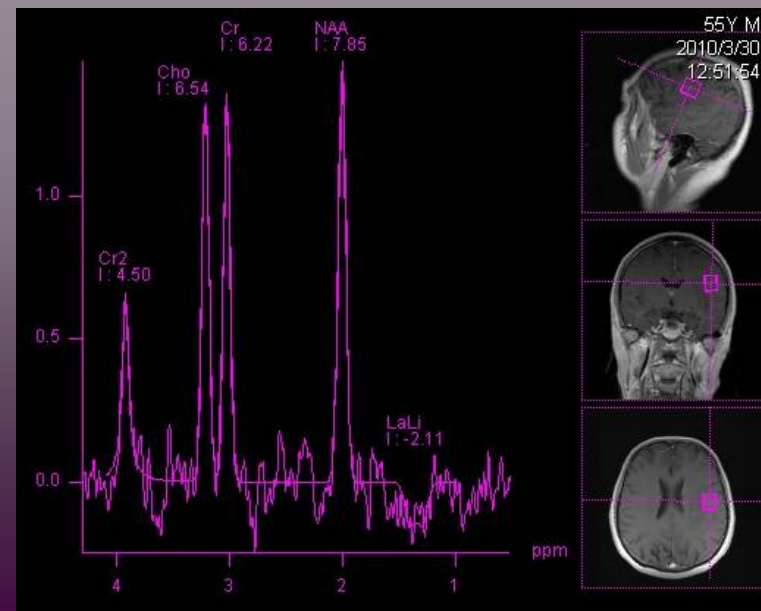
rCBV



DVO



ADC



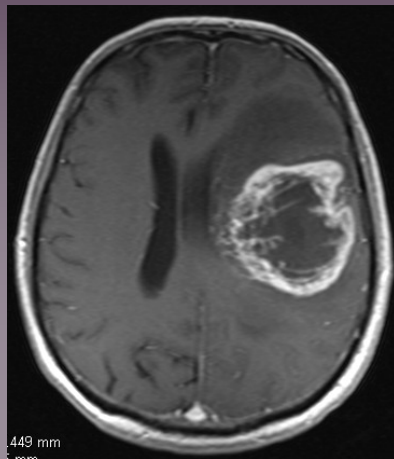
MR 55 r.



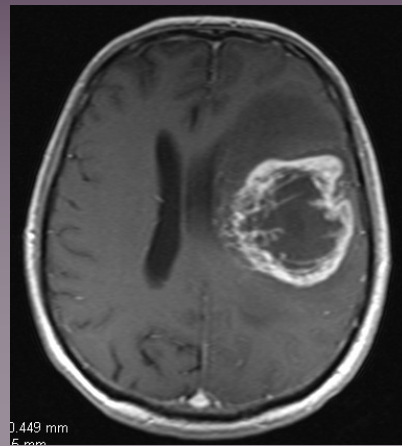
CTS 30.04.2010

Fibrilárny astrocytóm
WHO gr. II

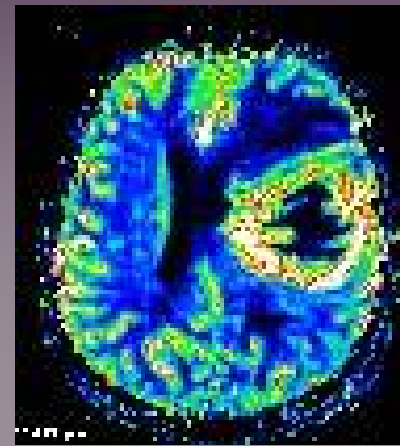
MR 55 r. 20.08.2010
OP, hist.: glioblastóm WHO gr.IV



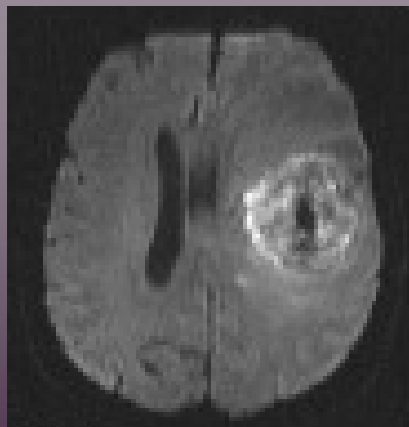
T2vo



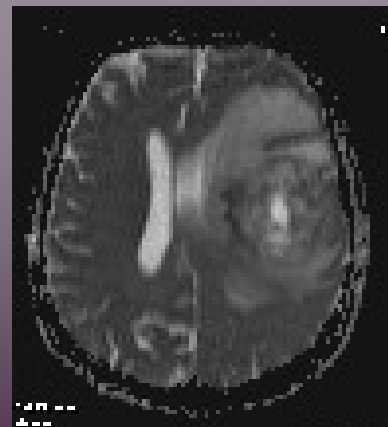
T1vo_Gd



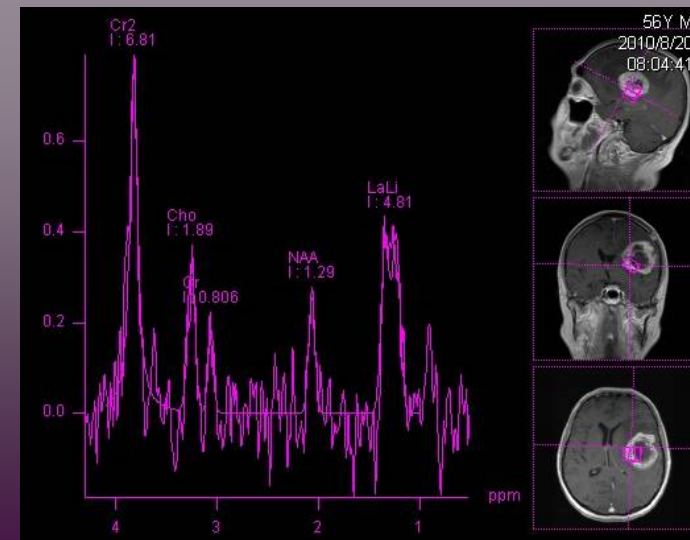
rCBV



DVO



ADC

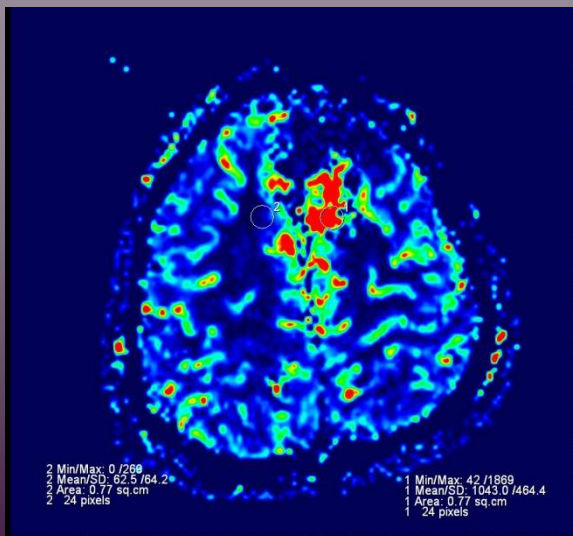
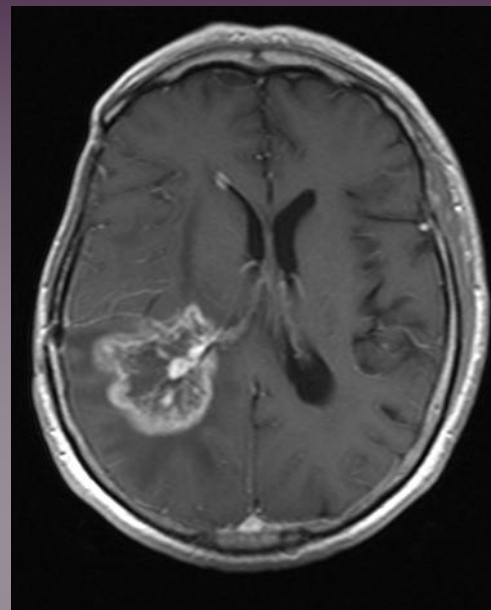
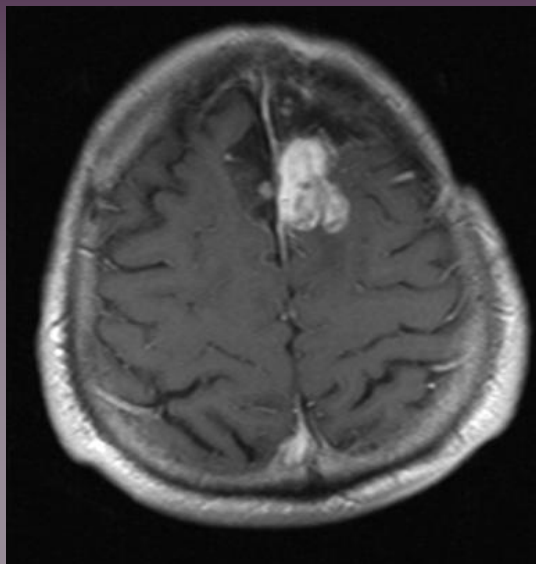


Multimodálna liečba GBM

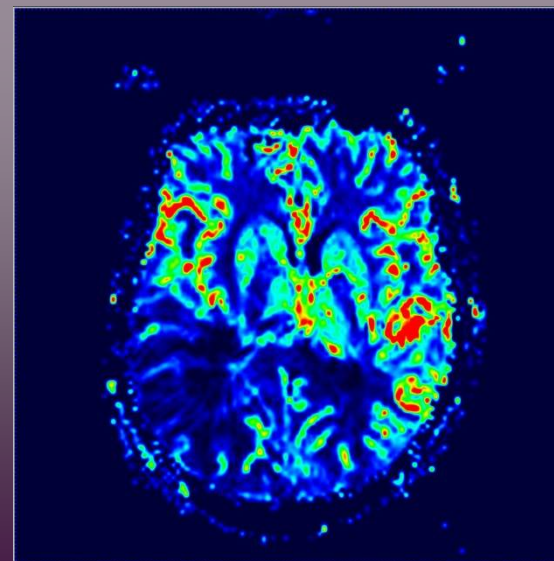
- *11% > 3 roky 2001-2003*
- *2,2% > 3 roky 1990*

- *liečbou-indukovaná toxicita: 46%:*
 - Radiation-induced leukoencephalopathy
 - Radiation necrosis

Perfúzne MR monitoring liečby

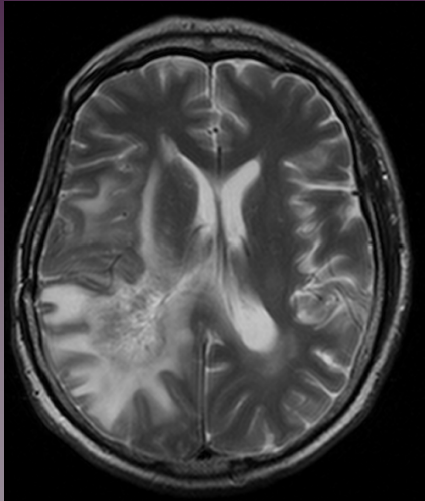


recidíva

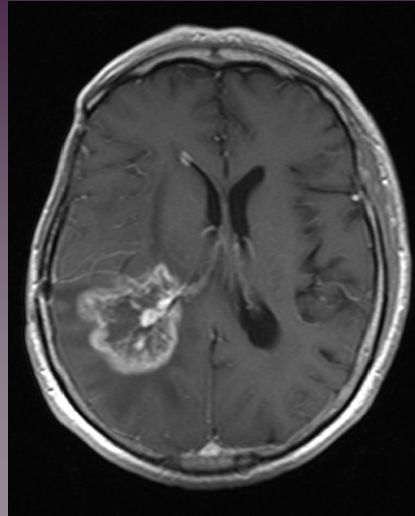


RN

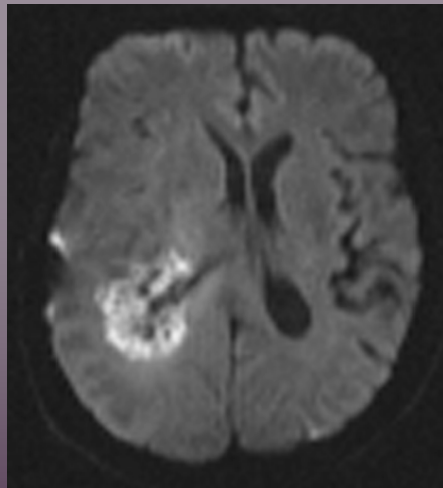
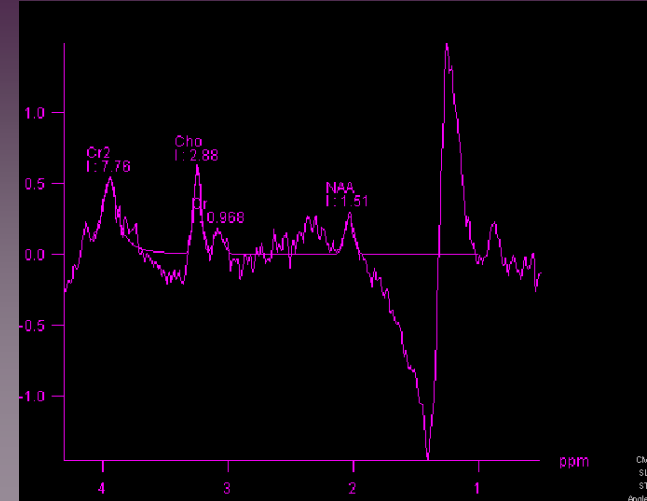
RN



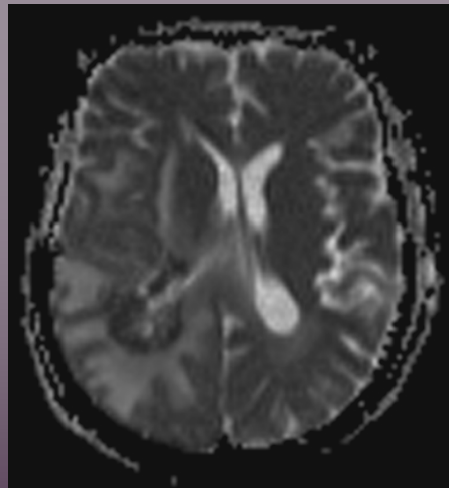
T2



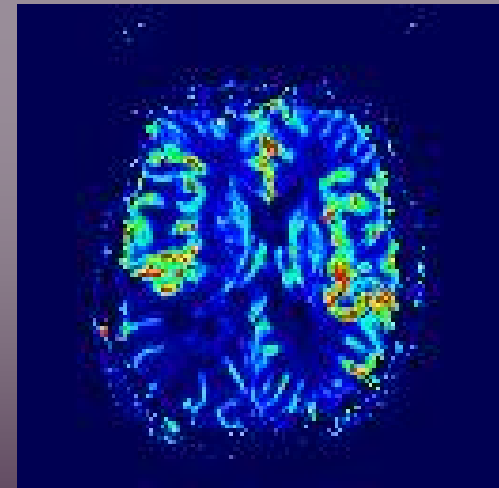
T1 Gd



DVO



ADC



pMR CBV

Ľ. Pružincová.....V. Belan: MR imaging of late radiationtherapy- and chemotherapy-induced injury: a pictorial essay. Eur Radiol (2009) 19: 2716–2727

Koregistrovaná fúzia (KRF)

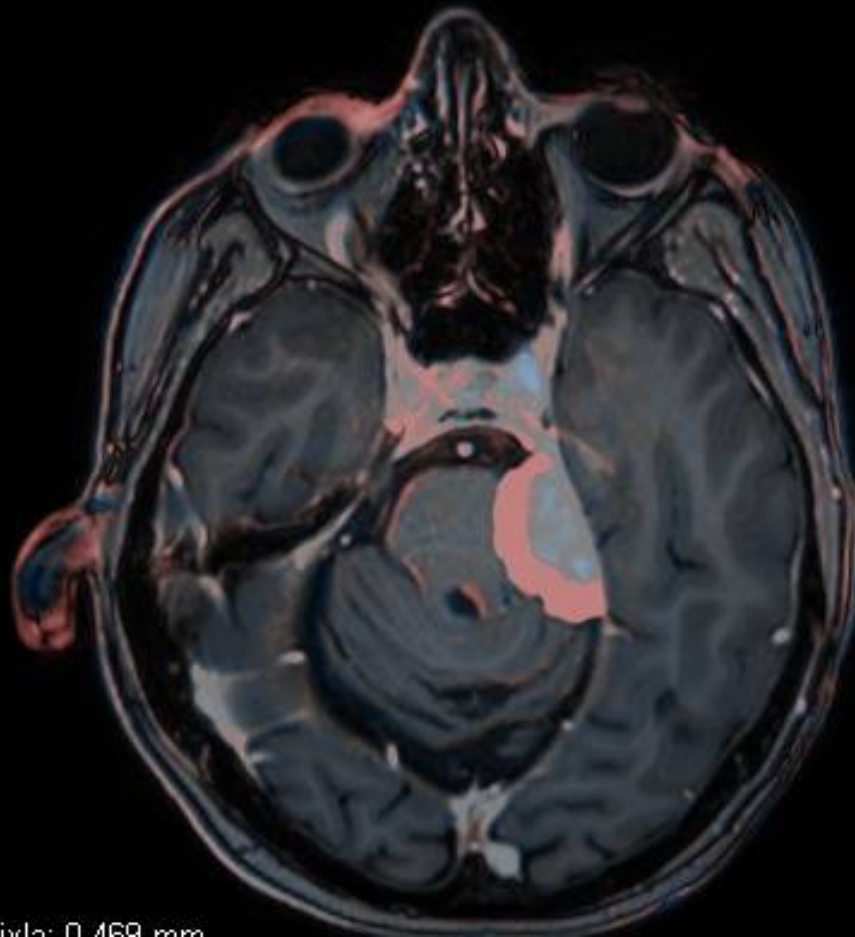
KRF_TRA_052017-122015

4

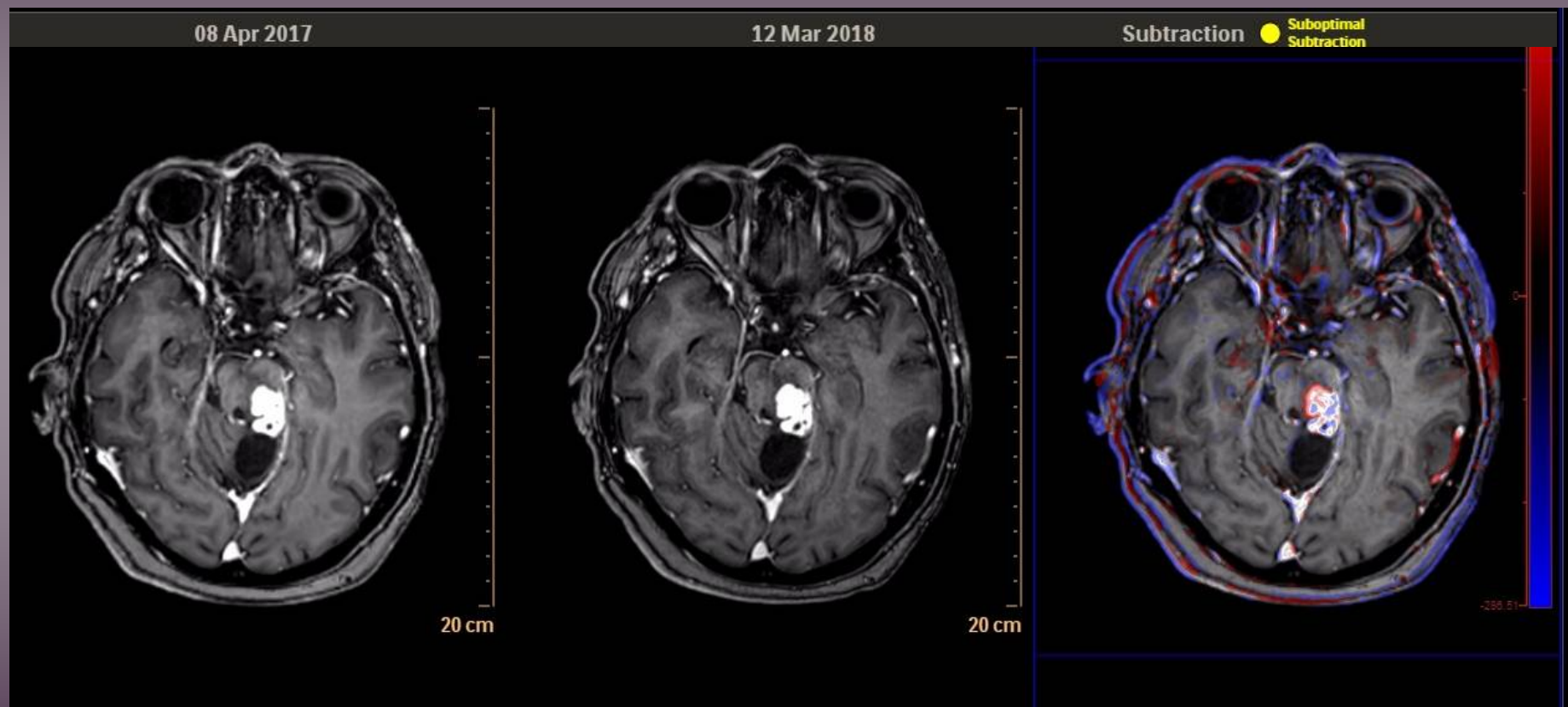
PDG17000

R

Volkert's size: 0.469 mm

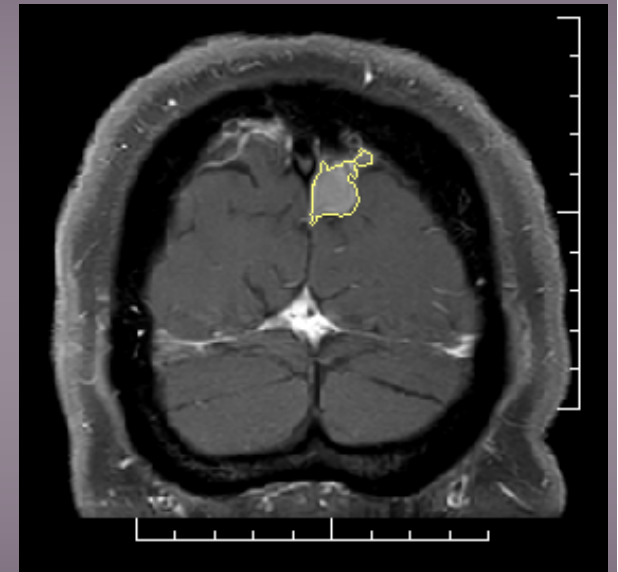
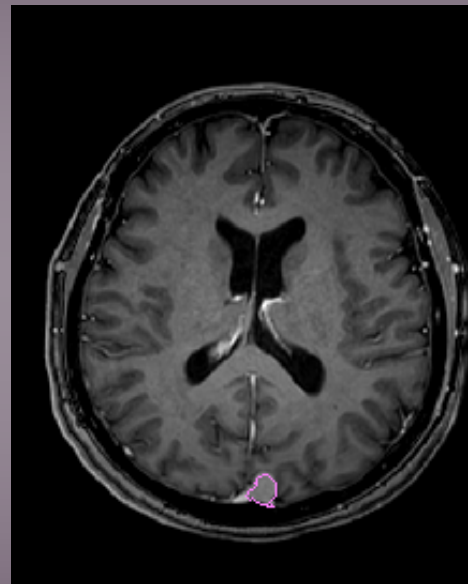
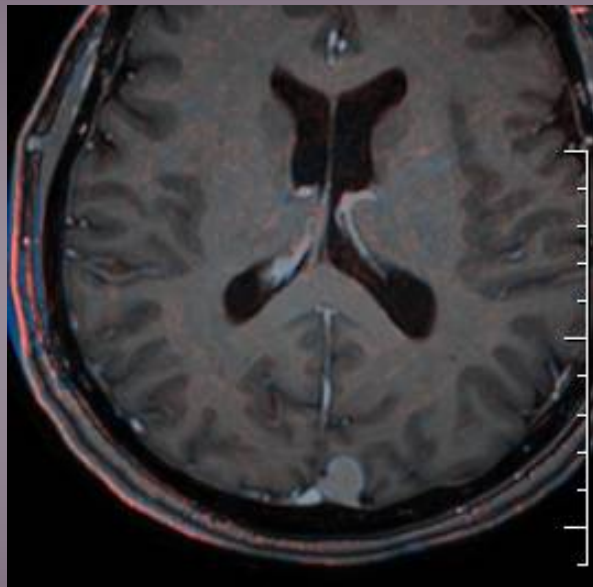




Komparatívne BI (COBI)



Longitudinálna koregistrovaná fúzia (LKF)

Volumetria



Správa ROI			
Viditeľnosť	Názov	Objem (ccm)	
<input checked="" type="checkbox"/> 	COR_T1_032018	0.6	M
<input checked="" type="checkbox"/> 	COR_T1_032018	0.7	M