Blood-Brain Barrier disruption after AIS treated with Mechanical Thrombectomy: a DCE-MRI study

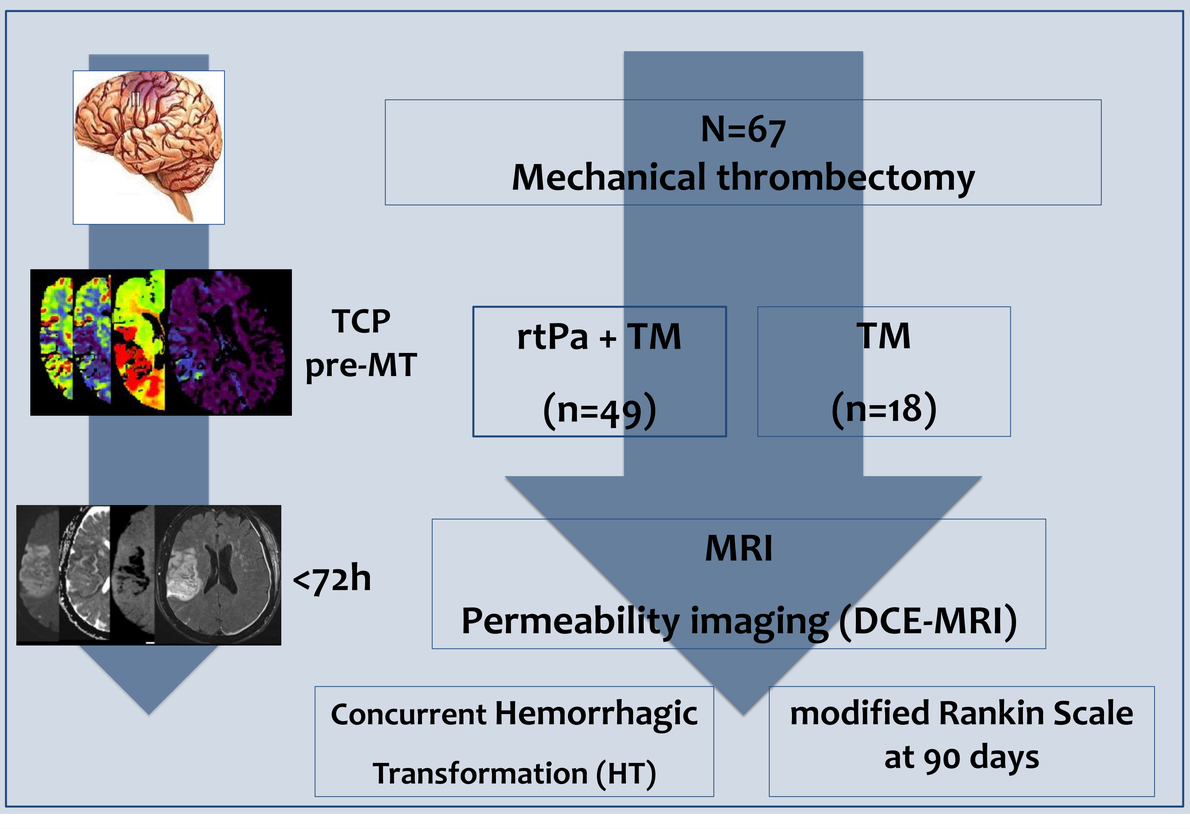
Carlos Laredo, Arturo Renú, Raúl Tudela, Antonio López, Laura Llull, Salvatore Rudilosso, Xabier Urra, Víctor Obach, Laura Oleaga, Ángel Chamorro, Sergio Amaro.

Comprehensive Stroke Center, Hospital Clínic, Barcelona, Spain.

Background and Objective

Blood-Brain Barrier disruption (BBBd) may impair the efficacy of mechanical thrombectomy (MT). We aimed to investigate the predictors of diffuse BBBd evaluated through Dynamic Contrast- Enhanced (DCE)-MRI after acute ischemic stroke treated with MT.

Methods



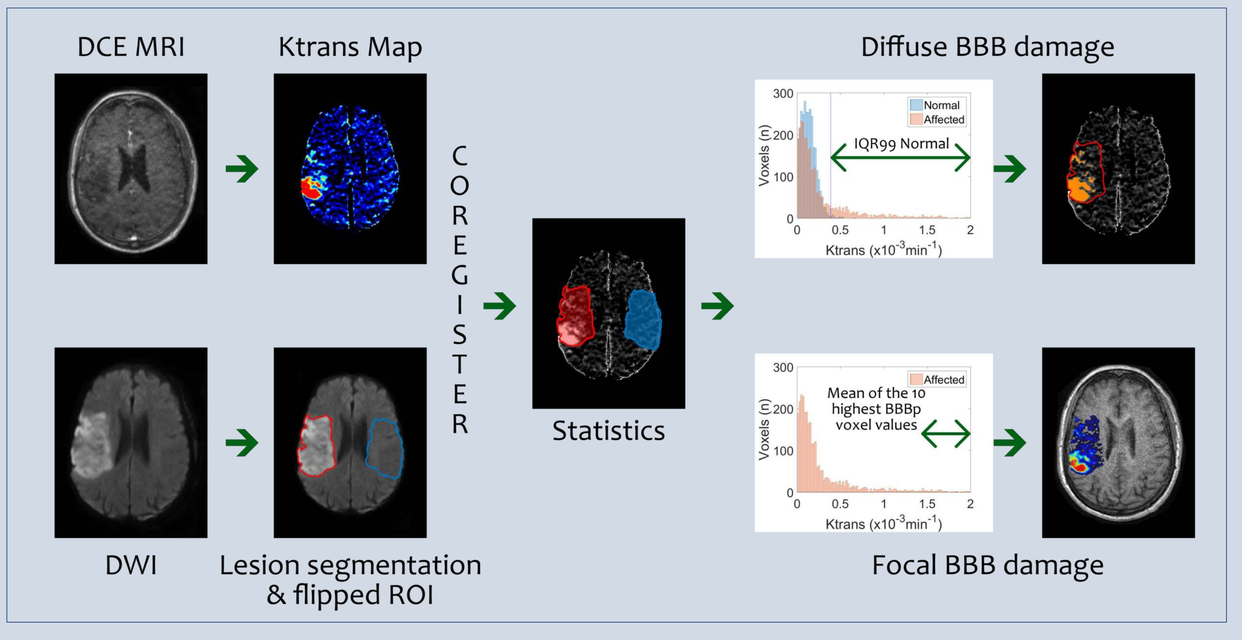


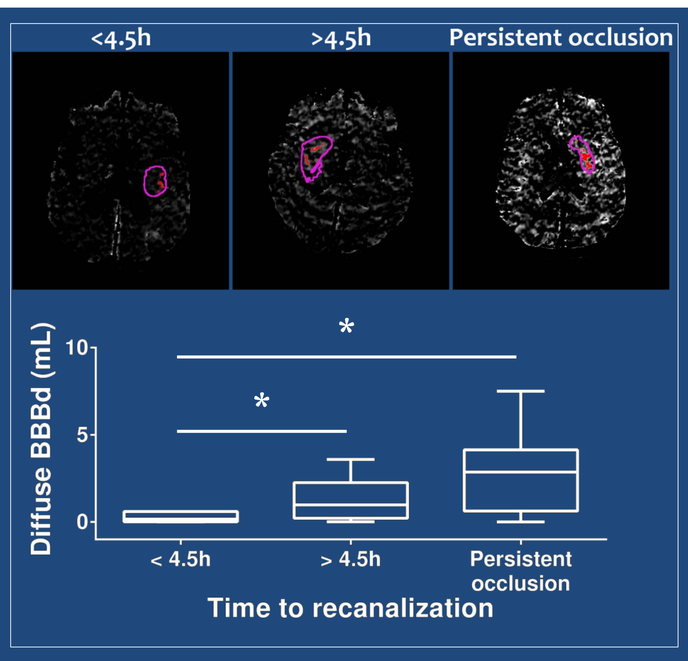
Figure. DWI lesion volumes were segmented by means of a semi-automated thresholding method. BBB permeability (BBBp) was quantitatively assessed from DCE-MRI acquisition using the Patlak pharmacokinetic model. A thresholding procedure was used to obtain the volume of tissue with severely increased BBBp in the affected hemisphere (diffuse BBBd). Significantly increased BBBp was defined as regions with Ktrans higher than the 99th percentile of the contralateral non-ischemic tissue (focal BBBd).

Results

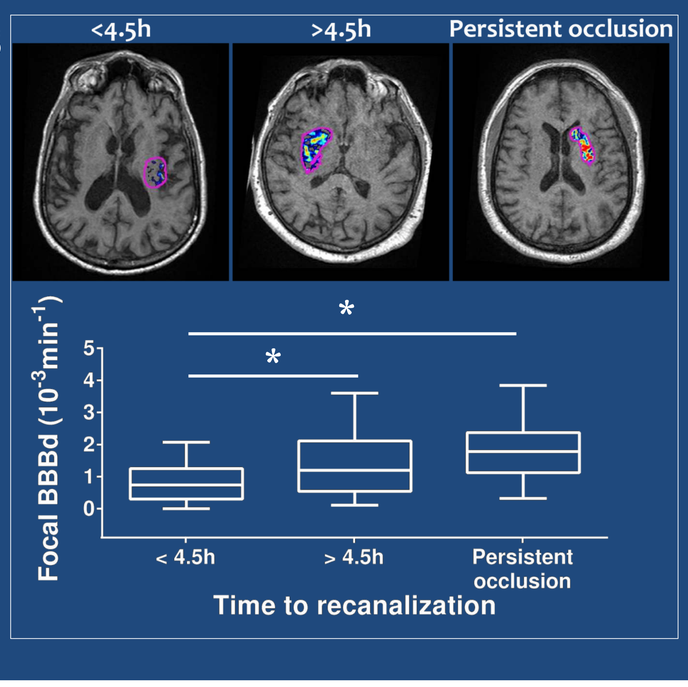
Main traits of study population	N=67
Age (years)	73 (60-80)
Baseline NIHSS	18 (14-22)
Leukocyte count at admission	8.9 (7.0-10.4)
ASPECTS score at baseline CT	9 (8-9)
Nonviable tissue on CTP (ml)	20 (9-36)
Hypoperfused tissue on CTP (ml)	130 (99-189)
MT related variables	
Time to MT onset (min)	180 (114-301)
Prior rtPA, n (%)	33 (49)
Number of device passes	2 (1-4)
TICI 2b-3, n (%)	50 (75)
Time to recanalization (min)	229 (152-338)
Follow-up variables	
Ktrans w/n DWI lesion (x10^{-3} min^{-1})	0.73 (0.37-1.11)
Diffuse BBBd (ml)	0.6 (0.14-2.81)
Focal BBBd (x10^{-3} min^{-1})	1.16 (0.5-1.90)
Final infarct volume (ml)	27 (7-68)
Parenchymal hematoma, n (%)	14 (20)
mRS>2 at day 90, n (%)	38 (57)

In comparison with recanalization within the first 4'5 hours after stroke onset, the volume of diffuse and focal maximal BBB disruption was significantly higher in patients with delayed recanalization and in those with persistent occlusions at follow-up, as shown in figure **A** and **B**.

A



B



	Whole population (n=67)	Recanalized patients (n=50)
Diffuse BBBd (ml)	**Exp(B) (95%CI), p**	**Exp(B) (95%CI), p**
Leukocyte count (per IQR)	1.192 (1.073-1.323); p=0.001	1.171 (1.033-1.326); p=0.013
Hypoperfused tissue (per 10ml)	1.019 (1.000-1.037); p=0.048	1.031 (1.009-1.053); p=0.005
Recan >4.5 h (vs <4.5h)	1.426 (1.089-1.867); p=0.010	-
Persistent occlusion (vs recan <4.5h)	1.657 (1.220-2.250); p=0.001	-
Time to recanalization (per IQR)	-	1.156 (1.023-1.305); p=0.020
Focal BBBd (per unit, 10^{-3} min^{-1})	**Exp(B) (95%CI), p**	**Exp(B) (95%CI), p**
Leukocyte count (per IQR)	1.194 (0.962-1.482); p=0.108	1.074 (0.831-1.387); p=0.587
ASPECTS score (per IQR)	0.708 (0.575-0.873); p=0.001	0.647 (0.506-0.827); p=0.001
Recan >4.5 h (vs <4.5h)	1.453 (0.818-2.581); p=0.202	-
Persistent occlusion (vs recan <4.5h)	2.439 (1.312-4.532); p=0.005	-
Time to recanalization (per IQR)	-	1.236 (0.960-1.591); p=0.100

Table. Predictors of BBB disruption: multivariate regression analysis

OR for poor outcome (mRS 3-6 at day 90)	
Diffuse BBBd	6.2 (1.7-22.5), p=0.006
Focal BBBd	1.4 (0.92-2.3), p=0.176
OR for Parenchymal Hematoma	
Diffuse BBBd	4.1 (1.2-13.8), p=0.023
Focal BBBd	9.8 (1.0-94.7), p=0.049

Table. Association of BBBd with clinical outcome and PH. Adjusted for baseline NIHSS and recanalization

Conclusions

Diffuse BBB-disruption was associated with higher pretreatment inflammatory status as well as with longer time of ischemia before recanalization or persistent occlusions. Focal severe BBB disruption was mainly related with increased severity of stroke at onset and persistent occlusions. These results highlight the relevance of early recanalization for protecting BBB integrity and give further support to the role of permeability imaging as a tool for the evaluation of adjunctive neuroprotective therapies.