Faculty of Science

EU FT-ICR MS

Visualization of Polyamines and Amino Acids Alterations in Neonatal Brain Hypoxic-Ischemic Injury in Rats by Mass Spectrometry Imaging

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Hypoxic-ischemic neonatal brain injury

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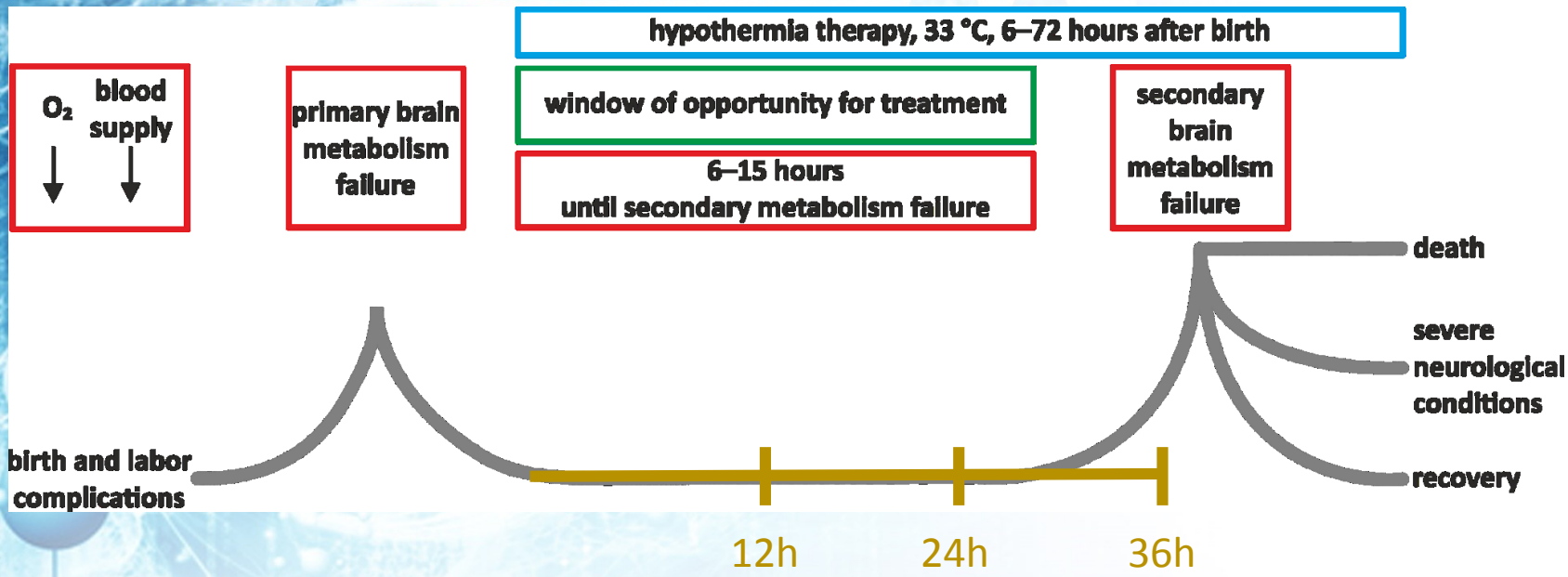
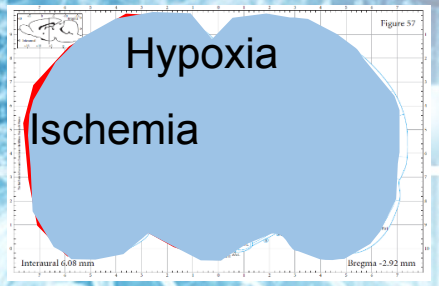


Aims

1) **MALDI-MSI** analysis **of small molecules**
2) **Time-dependent** alterations in a brain
3) Description of **post-primary brain metabolism failure**



Methods

Rice-Vannucci model of hypoxic-ischemic neonatal rat brain injury

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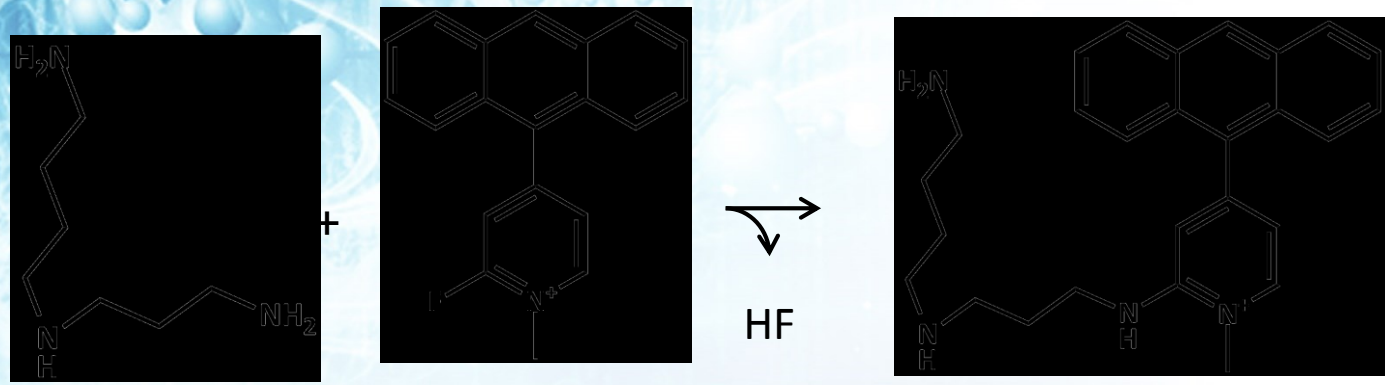
FMP-10 derivatization



Spermidine + FMP-10 → Single derivatized spermidine

Shariatgorji, M. et al., Nature Methods 2019

Molecules of interest

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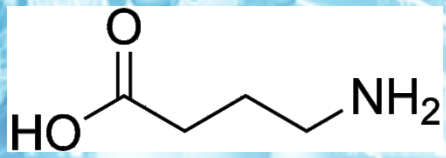
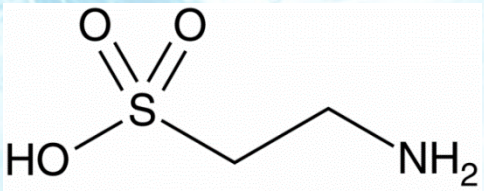
1) Aminoacids

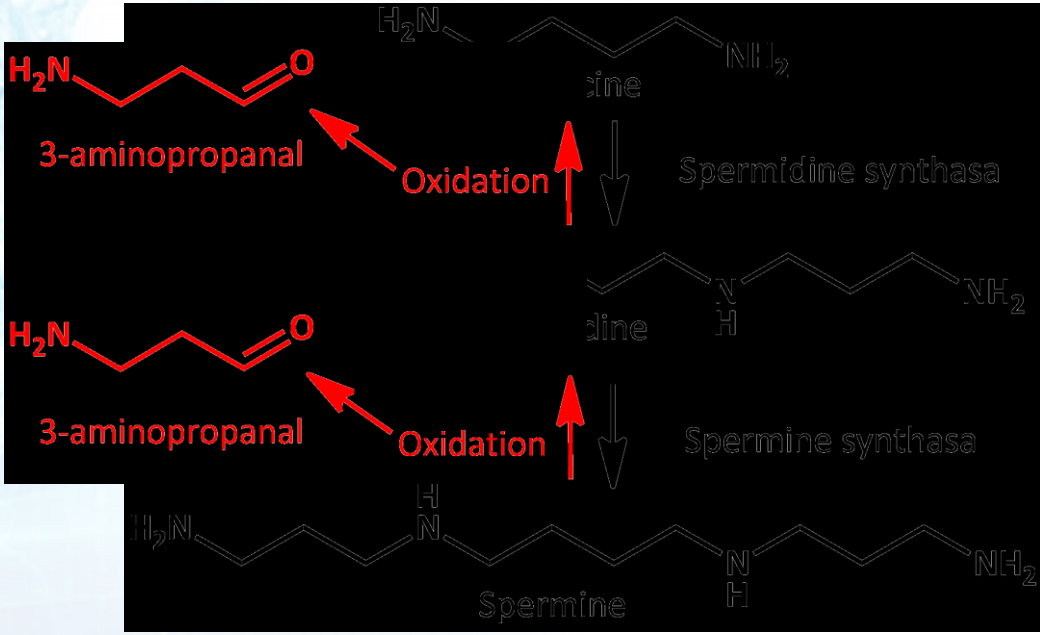


γ-aminobutyric acid (GABA)

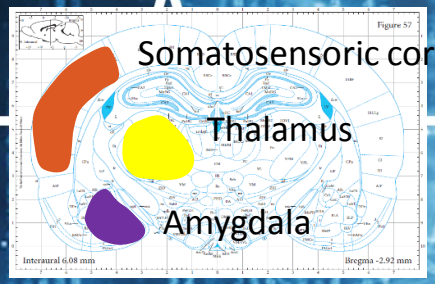


Taurine

2) Polyamines



Polyamines changes



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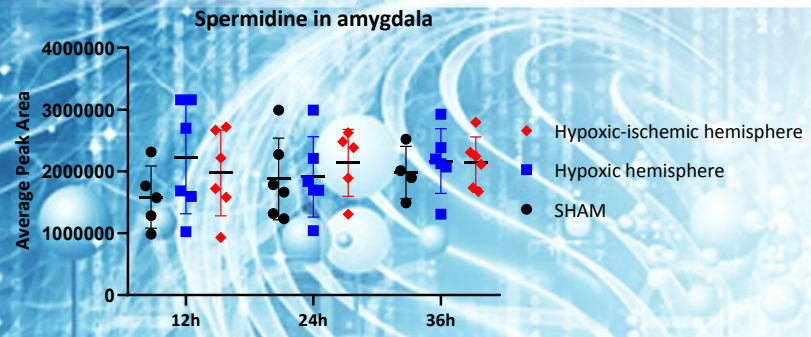

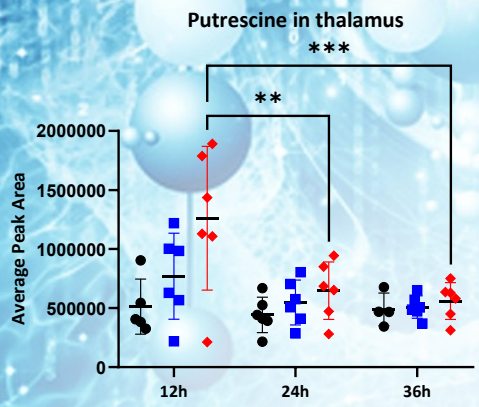

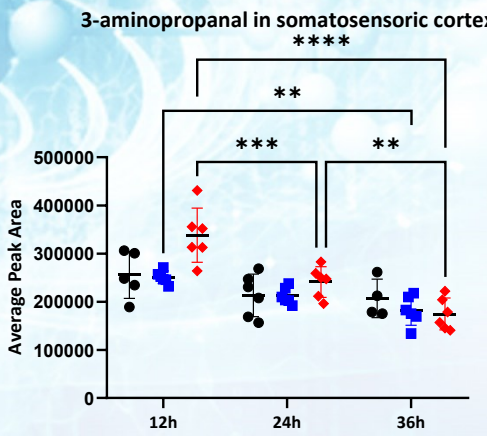

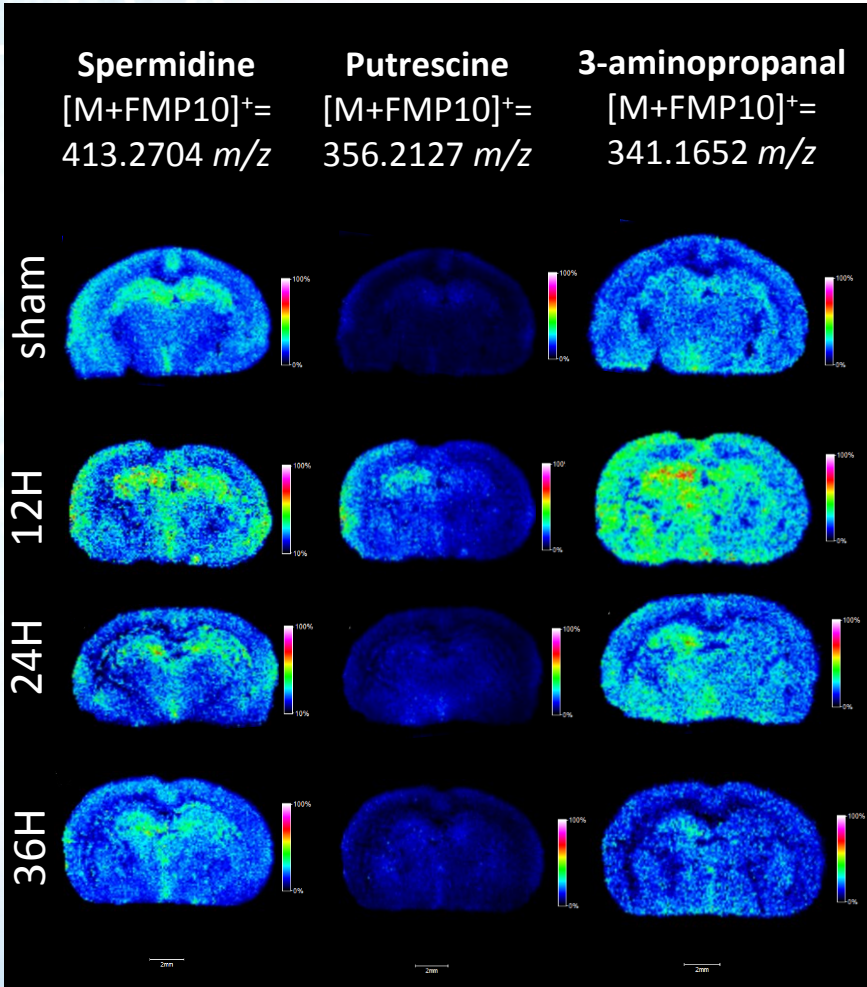

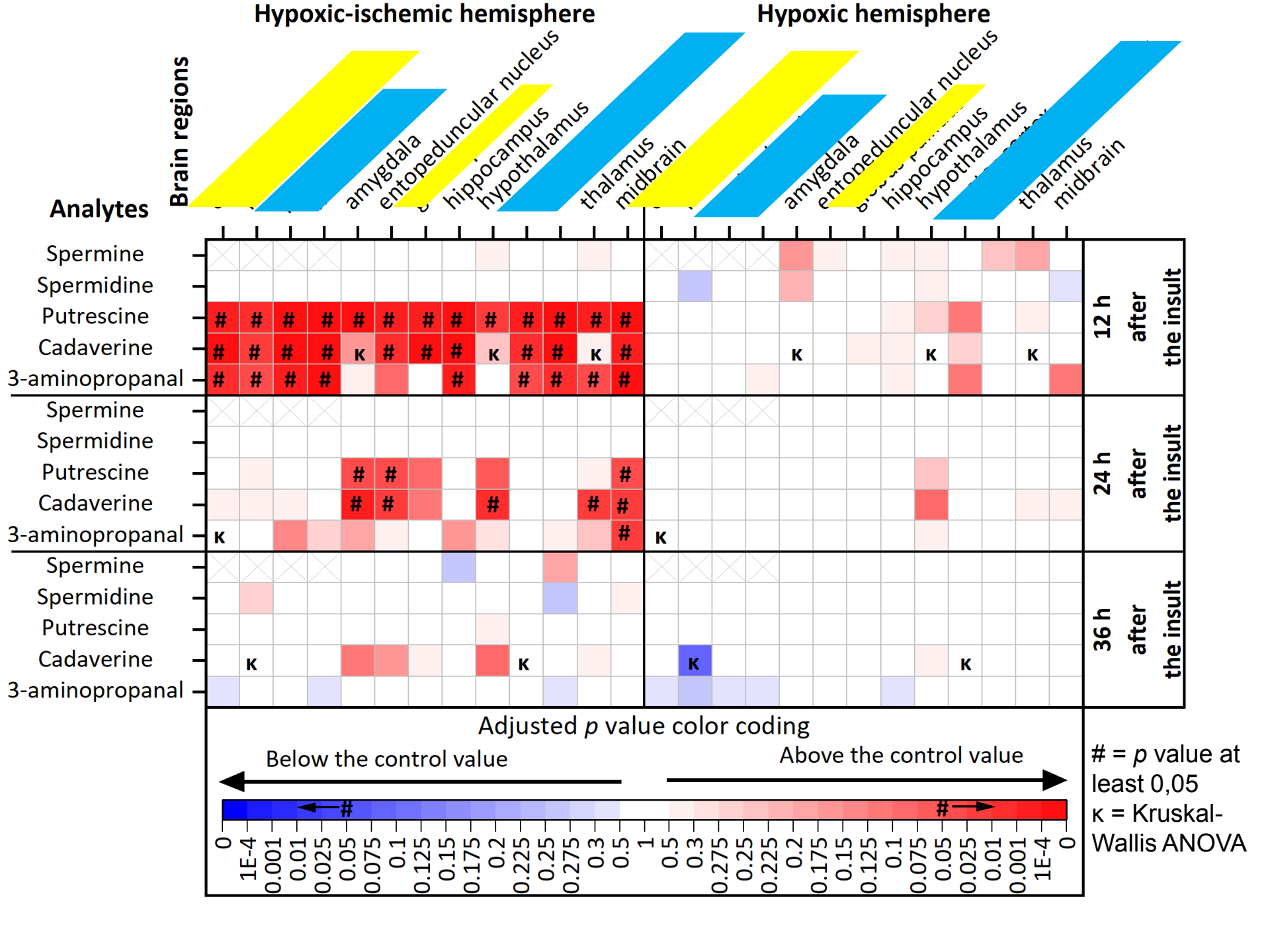
Hypoxic-ischemic hemisphere
Hypoxic hemisphere
Brain regions
amygdala
entopeduncular nucleus
hippocampus
hypothalamus
thalamus
midbrain
Analytes
Spermine
Spermidine
Putrescine
Cadaverine
3-aminopropanal
12 h after the insult
24 h after the insult
36 h after the insult
Adjusted p value color coding
Below the control value
Above the control value
0
1E-4
0.001
0.01
0.025
0.05
0.075
0.1
0.125
0.15
0.175
0.2
0.225
0.25
0.275
0.3
0.5
1
= p value at least 0,05
κ = Kruskal-Wallis ANOVA

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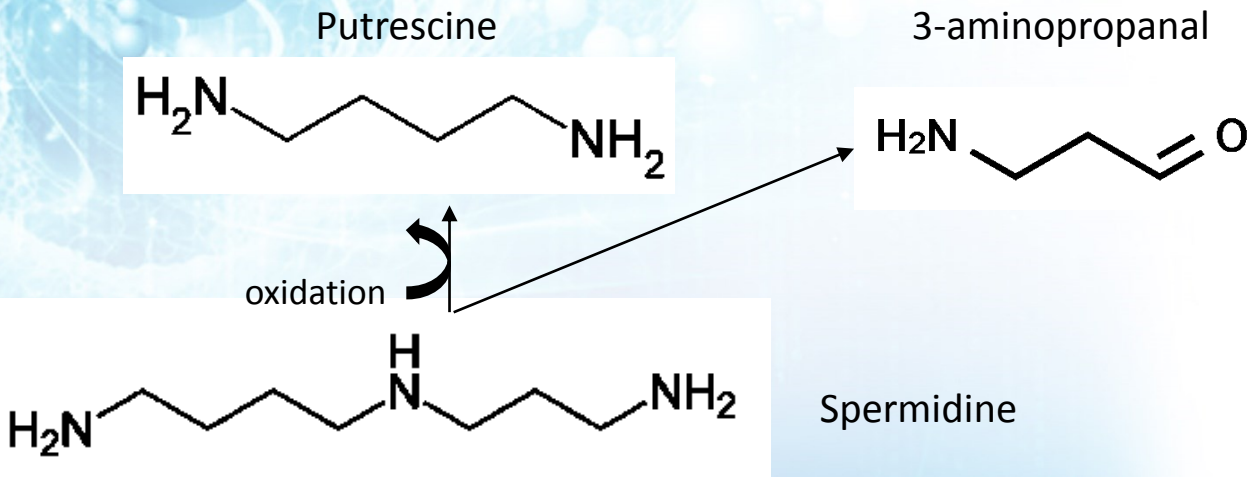
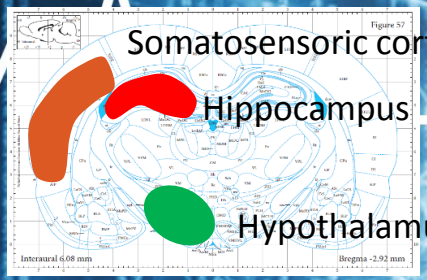
- **Increased level of putrescine, cadaverine, and 3-aminopropanal in the hypoxic-ischemic hemisphere 12 hours** after the insult
  - Putrescine and cadaverine could reflect the severity of ischemic cells injury (*Paschen, W. et al., Neurochemical Pathology, 1988; Shin, T. et al., Stem Cells Int., 2016*)
  - 3-aminopropanal generated from spermidine during ischemia leads to apoptosis (*Li, W. et al., Biochem J., 2003*)



Aminoacids changes



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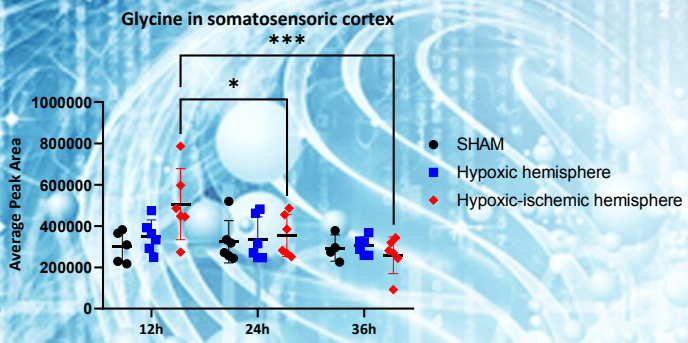

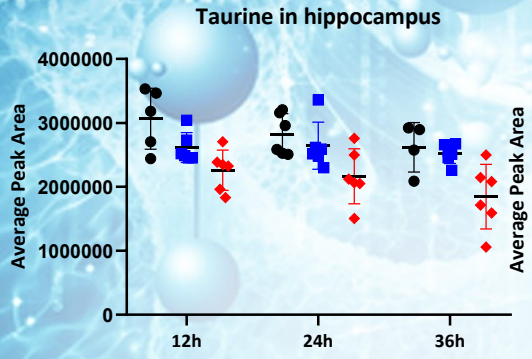

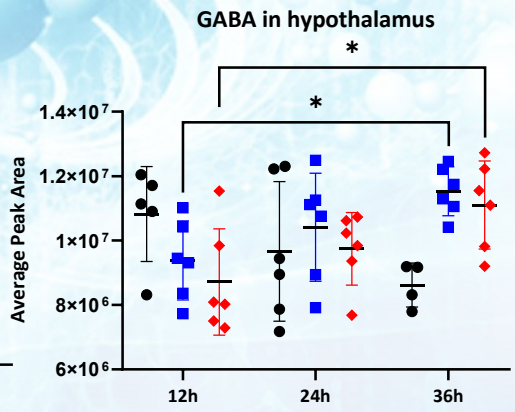

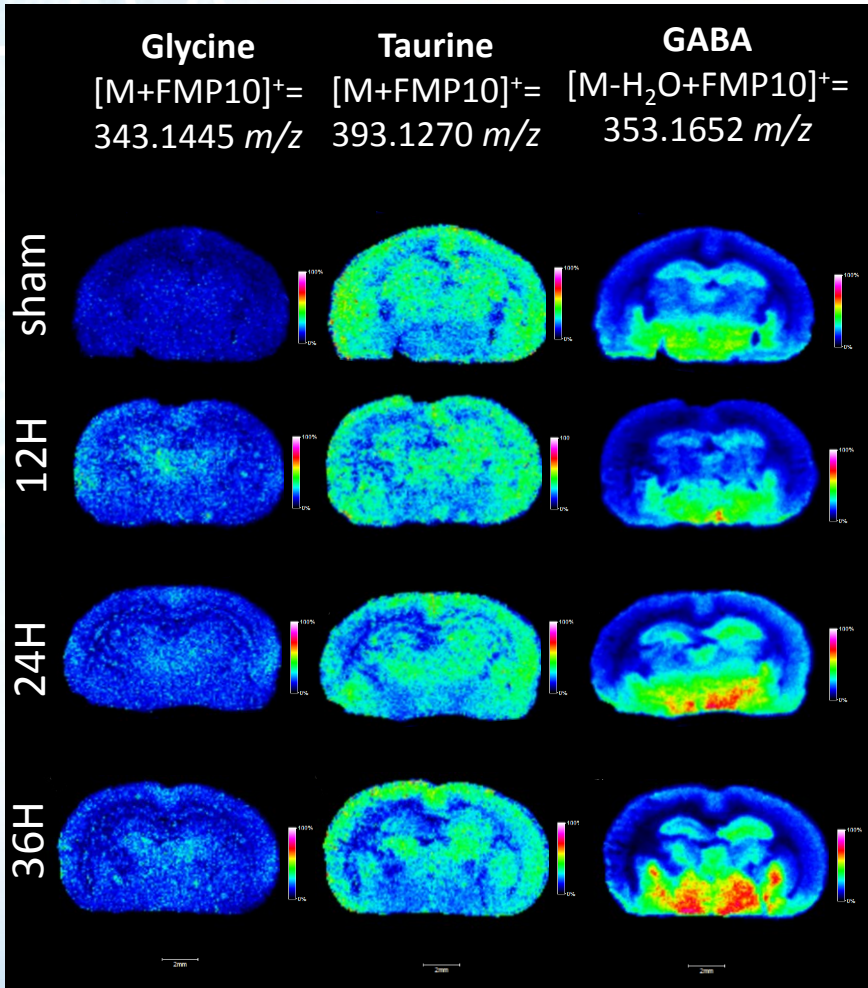

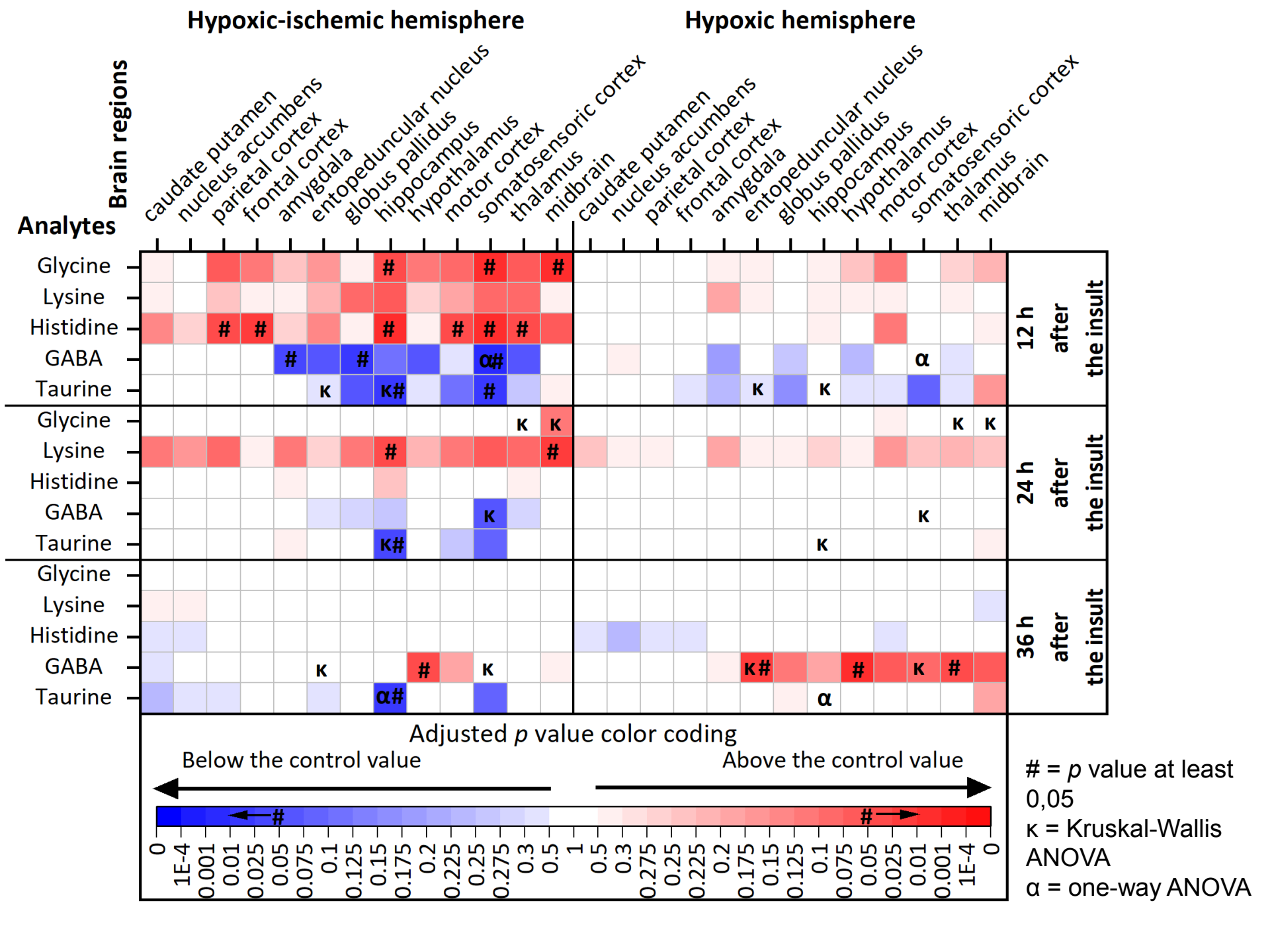
Hypoxic-ischemic hemisphere
Hypoxic hemisphere
Brain regions
caudate putamen
nucleus accumbens
parietal cortex
frontal cortex
amygdala
entopeduncular nucleus
globus pallidus
hippocampus
hypothalamus
motor cortex
somatosensoric cortex
thalamus
midbrain
Analytes
Glycine
Lysine
Histidine
GABA
Taurine
12 h after the insult
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0.175
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0.225
0.25
0.275
0.3
0.5
1
= p value at least 0,05
κ = Kruskal-Wallis ANOVA
α = one-way ANOVA

- Aminoacids **histidine** and **glycine** were significantly **higher in the hypoxic-ischemic hemisphere 12h** after the insult
  - Both aminoacids could play a role in neuroprotection as they could lower ischemic damage (*Adachi, N., Brain Research Reviews, 2005; Liu, R. et al, J Immunol, 2019*)

- **Taurine** showed **decreased** intensity trend **in all time points in the hypoxic-ischemic hemisphere,** which may worsen ischemic injury *(Menzie, J. et al, Brain Sci., 2013)*

- **GABA decreased** in the **hypoxic-ischemic hemisphere 12h** and **increased 36h** after the injury in the **hypoxic** only **hemisphere**

Summary

1) We spatialy visualized aminoacids and polyamines by MALDI-MSI
2) We found time-dependent alteration following HI injury
3) Most highlighted changes were seen 12 hours after HI injury

Acknowledgment

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