

TR-NIRS data patterns in ischemic stroke patients

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POLITECNICO
MILANO 1863

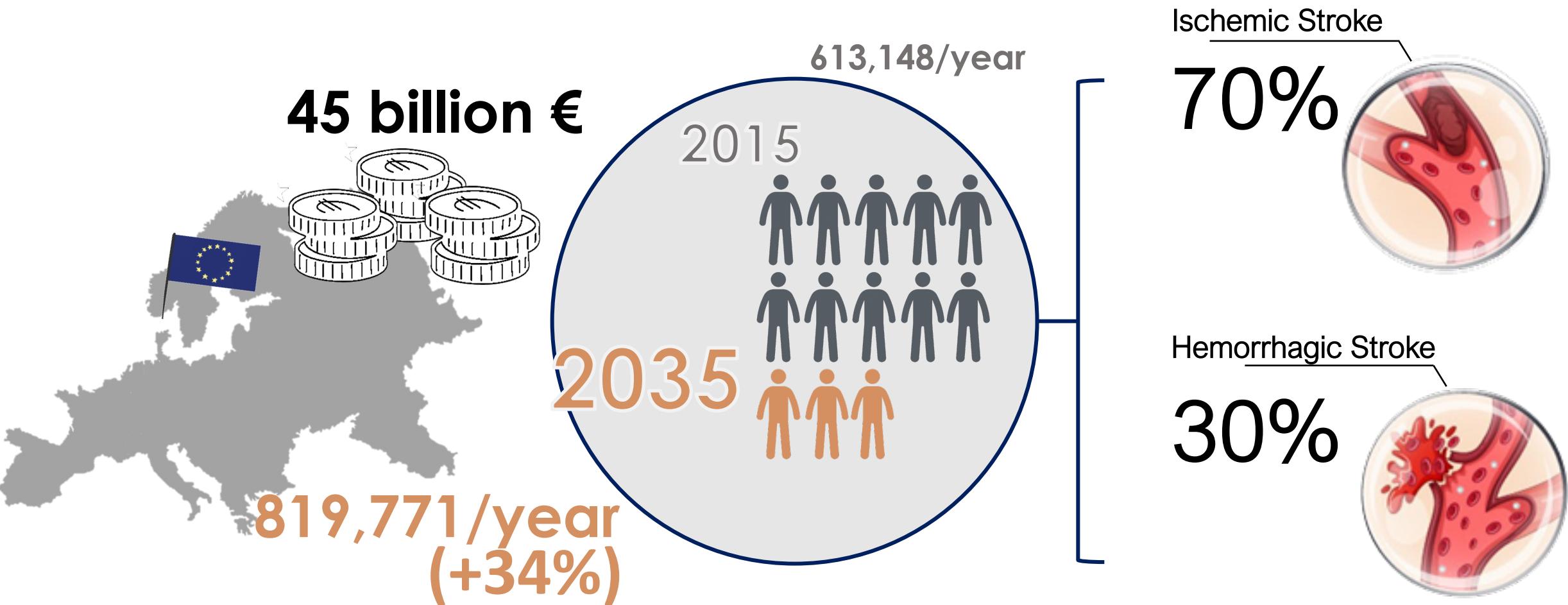


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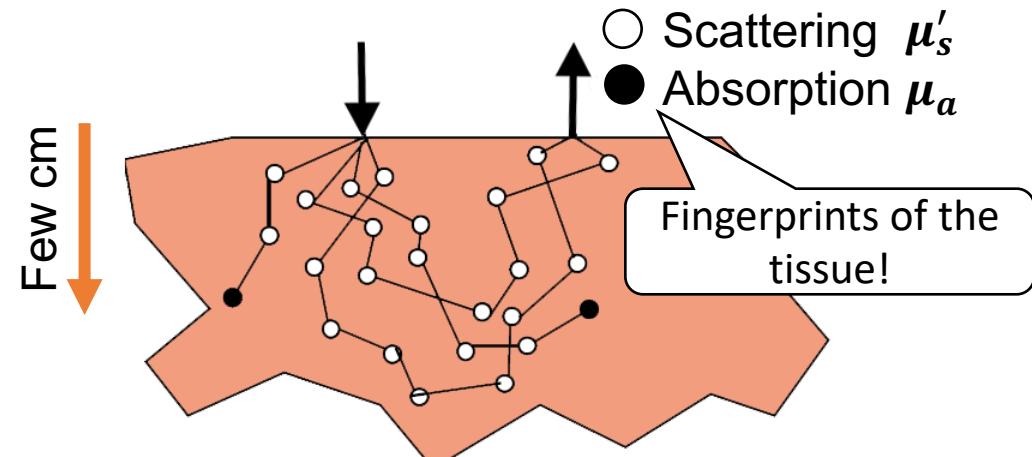
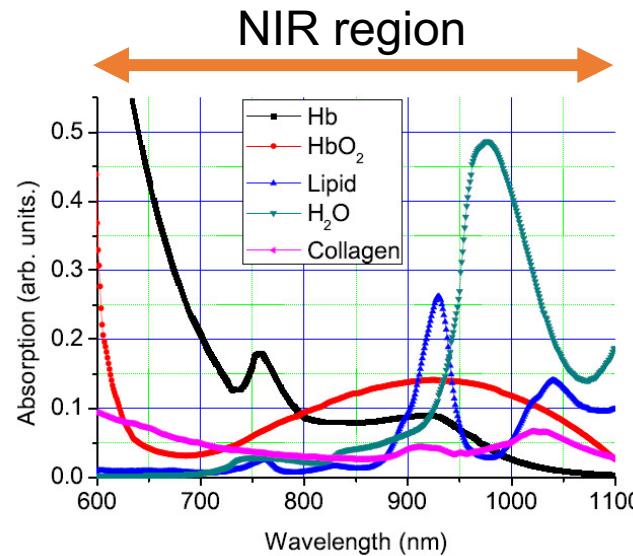
Società Italiana di Fisica
106° Congresso

Burden of stroke in Europe

'Burden of Stroke' report, Stroke Alliance For Europe, 2017



Near Infrared Spectroscopy (NIRS)

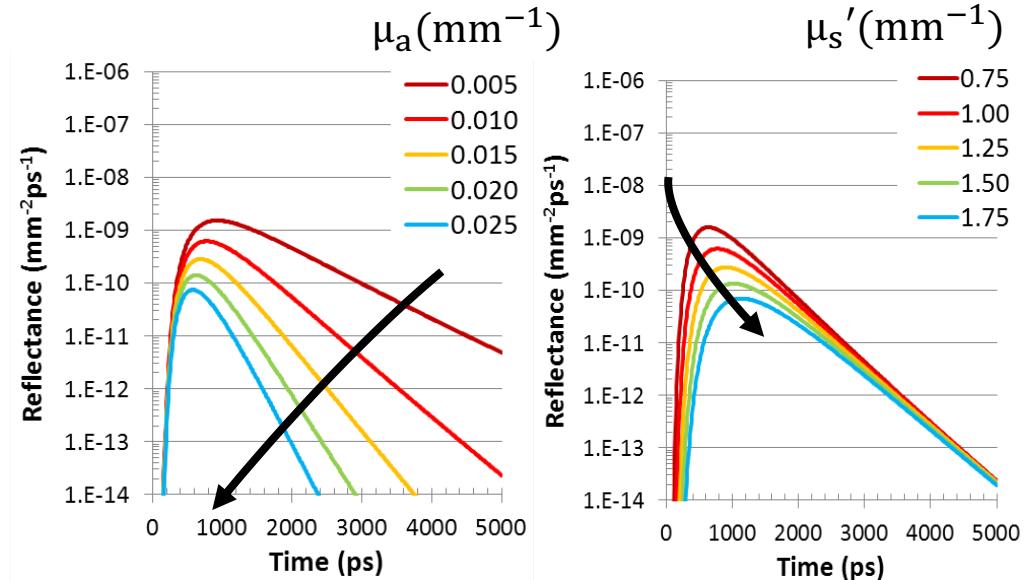
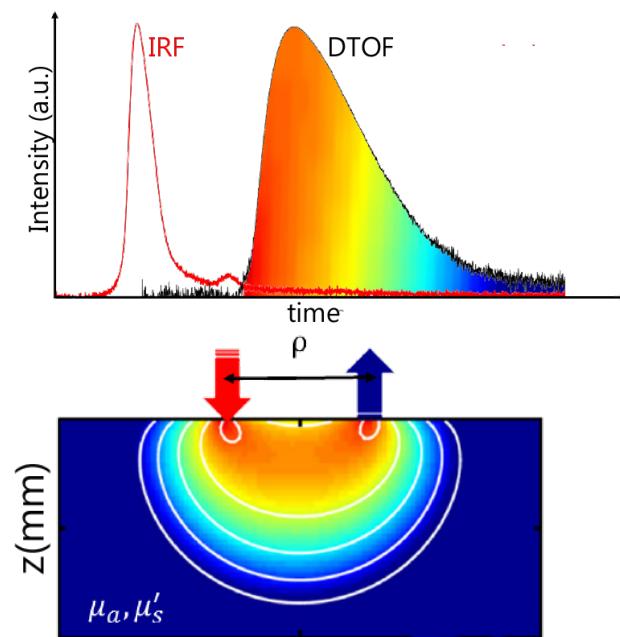


Probe different tissues non-invasively and real time

Three different modalities (CW, FD, **TR**)

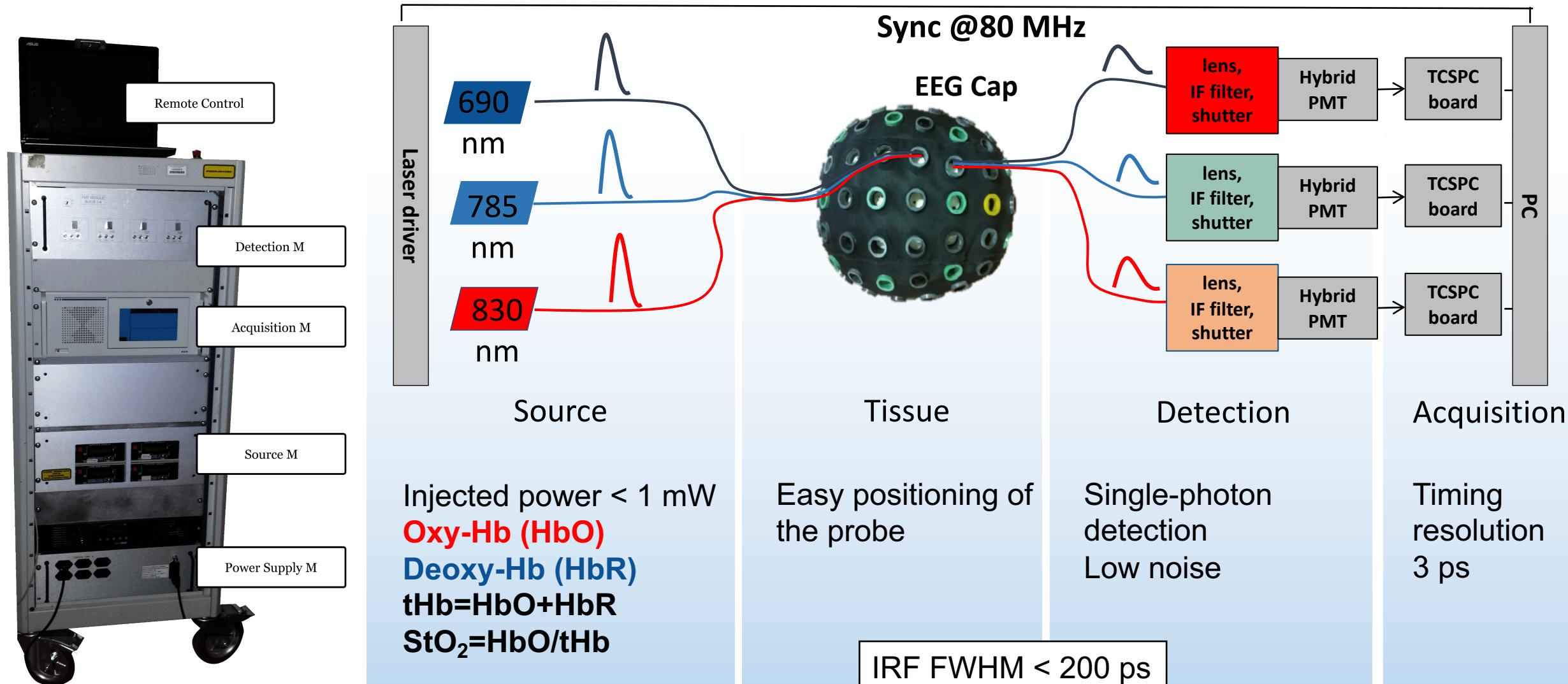
New set of info with clinical relevance
Hemoglobin (Hb) and Saturation (StO₂)

Time-Domain NIRS



- Photon distribution of time-of-flight (DTOF) encodes depth
- Absolute values of μ_a and μ'_s
- Absolute concentration of the main absorbers of the tissue $\overline{\mu_a}(\lambda) = \sum_i \epsilon_i(\lambda) \overline{c_i}$

TD-NIRS device for ischemic stroke

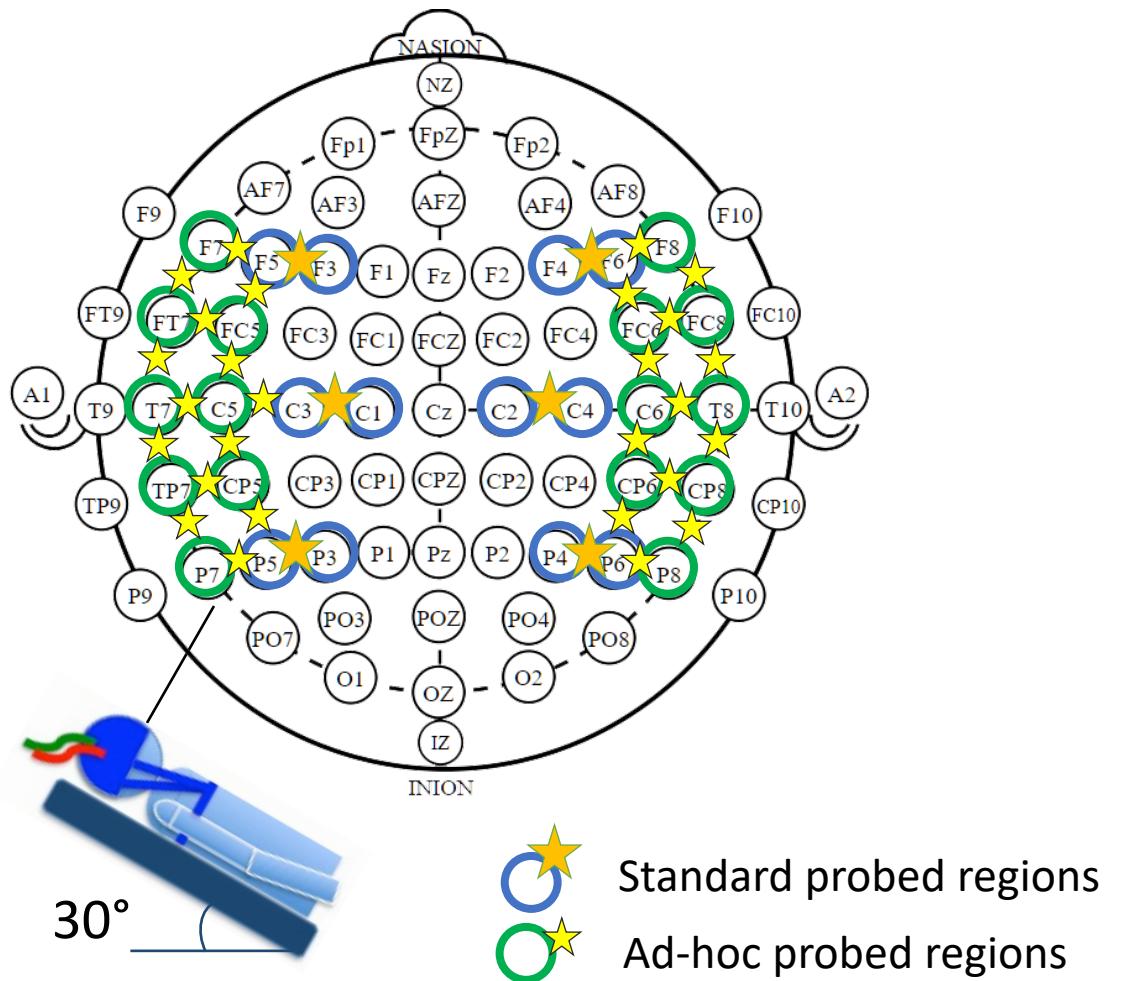


Main goals of the clinical study

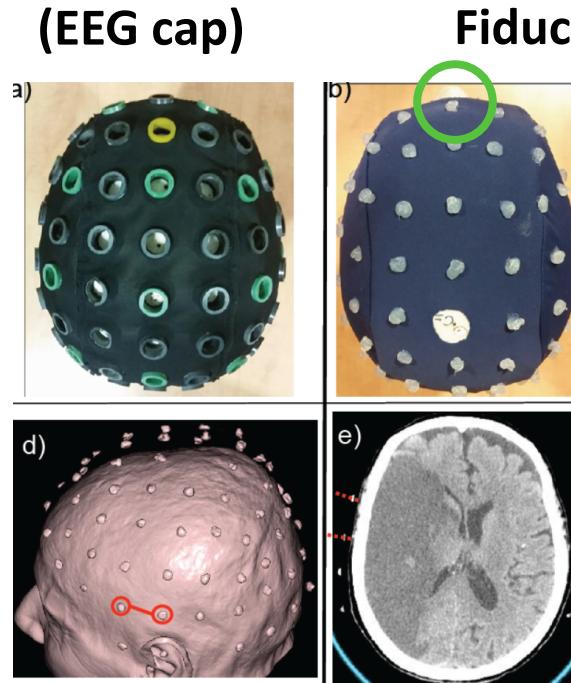
- 1
 - o Reproducibility data from a large data set of controls (healthy subjects)
 - o Reference values of hemoglobin species and StO₂

- 2
 - o Patients group vs controls'
 - o Patients according to recanalization status

Measurement protocol

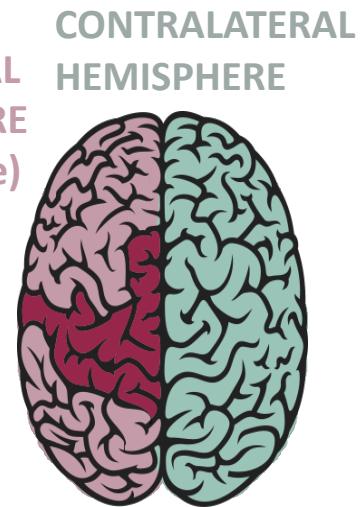


TR-NIRS
(EEG cap)



Fiducial markers

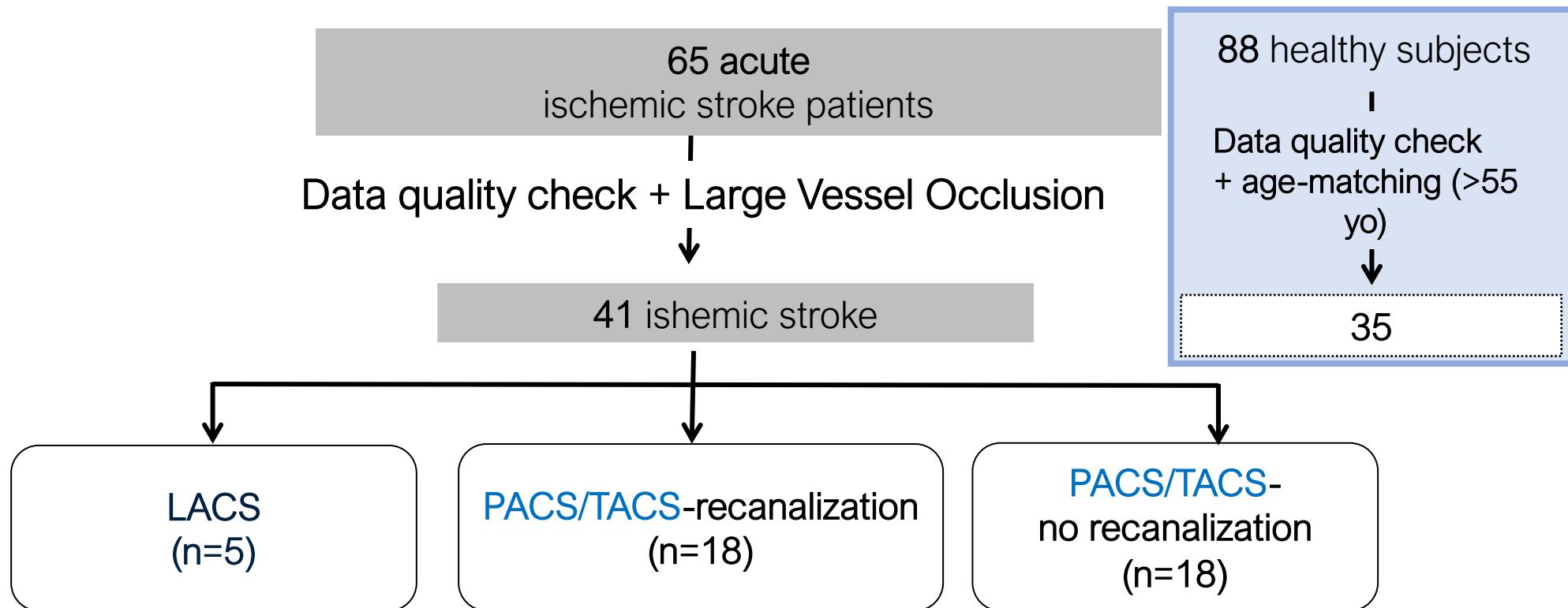
IPSILATERAL
HEMISPHERE
(non-stroke)



CONTRALATERAL
HEMISPHERE

For reproducibility assessment: 3 repetitions

TD-NIRS database

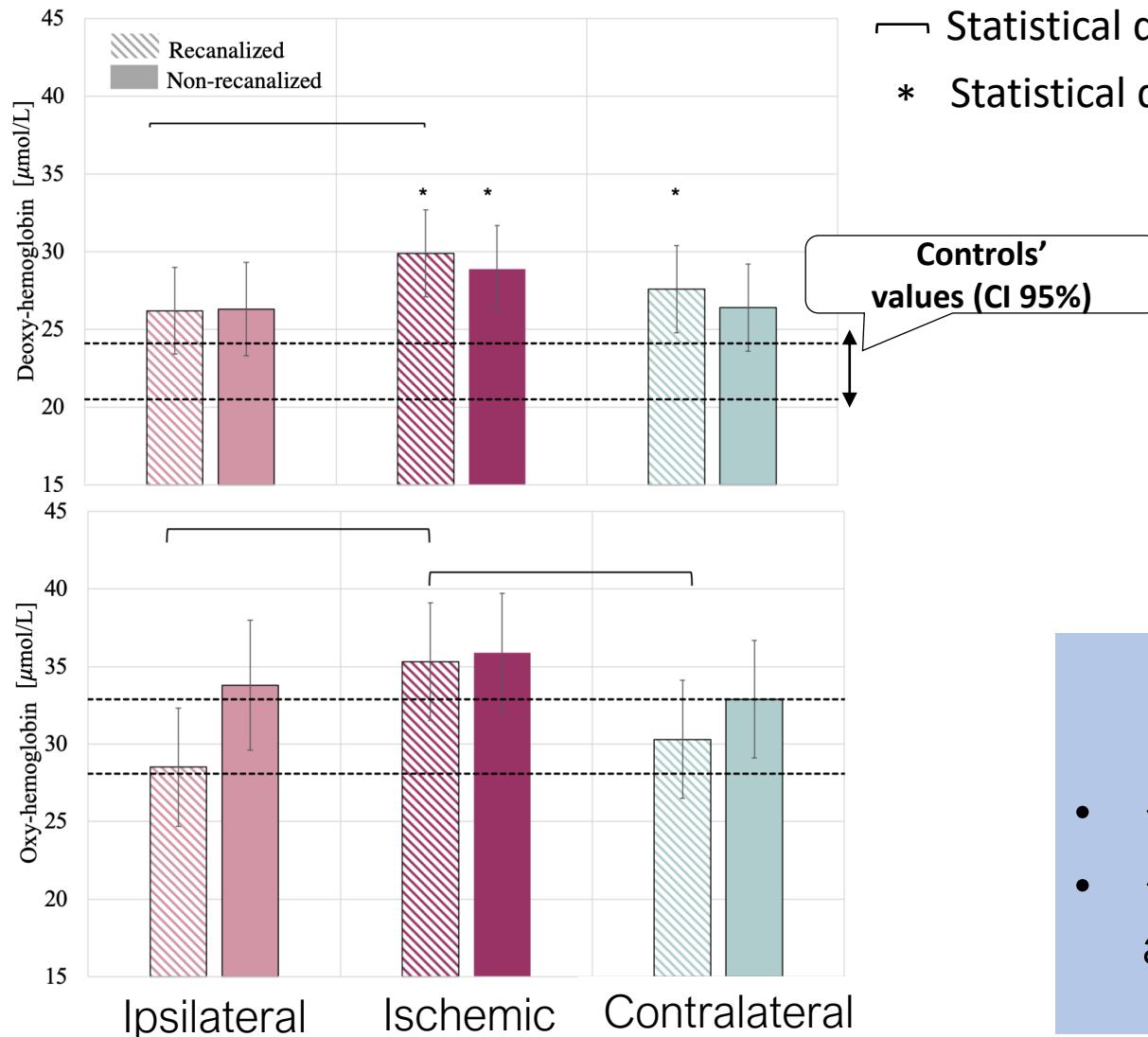


LACS → Lacunar Anterior Circulation Syndrome

PACS/TACS → Partial/Total Anterior Circulation Syndrome

- ↳ Non-Recanalized : blood flow is not restored
- ↳ Recanalized : restored blood flow

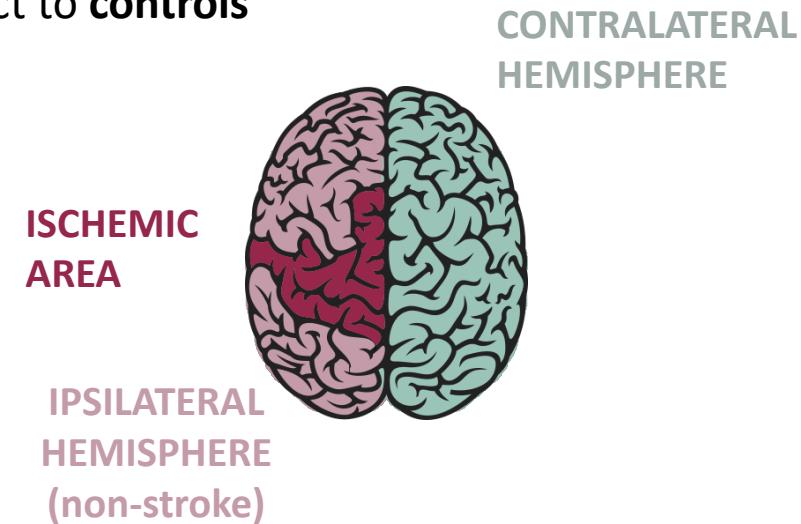
PACS/TACS .vs controls' values



— Statistical difference among **areas**

* Statistical difference with respect to **controls**

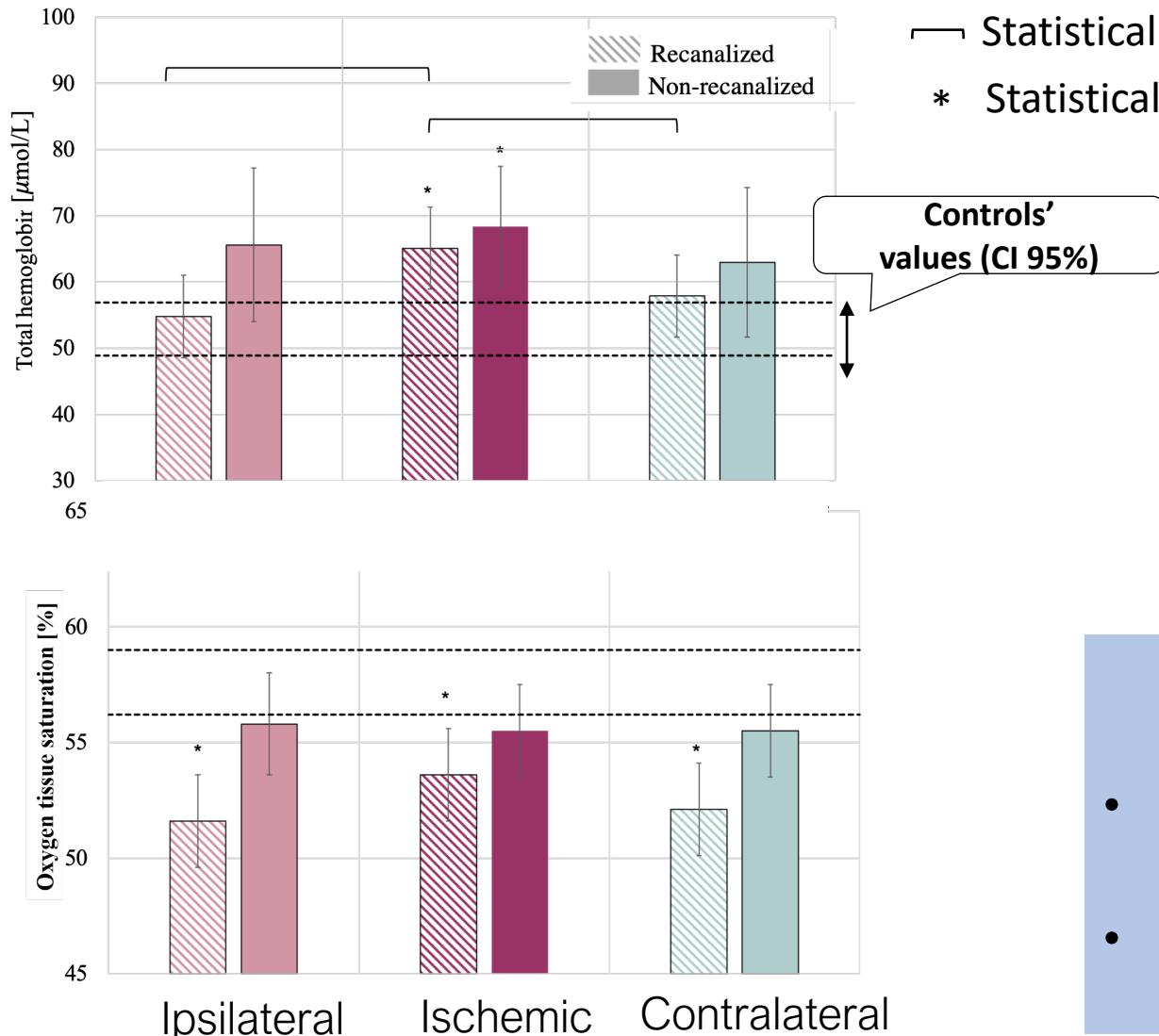
Controls'
values (CI 95%)



PACS/TACS

- ↑HbR in ischemic area
- ↑ HbO in ischemic area with respect to ipsilateral and contralateral hemisphere (recanalized)

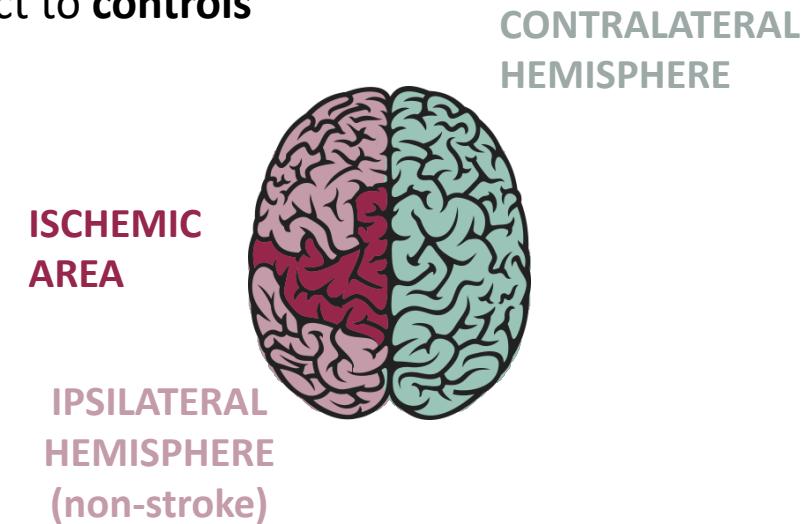
PACS/TACS .vs controls' values



— Statistical difference among **areas**

* Statistical difference with respect to **controls**

Controls'
values (CI 95%)



PACS/TACS

- ↑ tHb in the ischemic area and with respect to contralateral and ipsilateral hemisphere (recanalized)
- ↓↓ StO₂ for recanalized patients

Global effect on TD-NIRS data due to ischemic stroke

LACS patients do not show statistical differences (deep stroke) with respect to controls

- TR-NIRS feasible in real-life scenario
- Different patterns in TR-NIRS data for PACS/TACS

highlight the complexity of the problem

Global effect

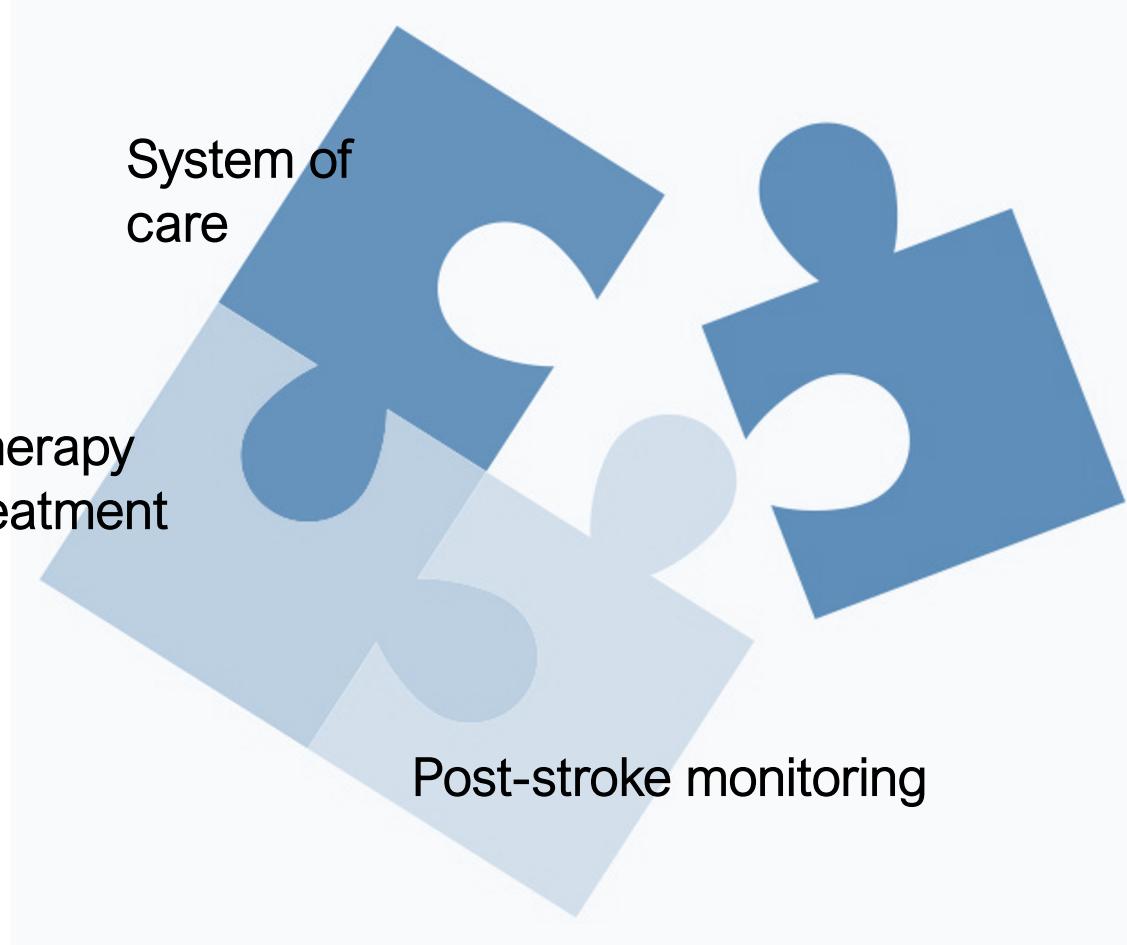
	Recanalized	Non-Recanalized
ISCHEMIC AREA	↑HbR, ↑tHb, ↓↓StO ₂	↑HbR, ↑tHb, ↓↓StO ₂
NON-STROKE IPSI	↑HbR, ↓↓StO ₂	↑HbR, ↓↓StO ₂
CONTROLATERAL	↑HbR, ↓↓StO ₂	↑HbR, ↓↓StO ₂

Hp: global hemodynamic compensation

Hp: Stagnant
blood/residual blood
flow

StO₂ Biomarker of metabolically active tissue

Conclusions and future perspective



Near Infrared Spectroscopy



- Global effect and TD-NIRS pattern
- Possible new biomarker for a better insight on ischemic stroke

What about the future..?

- Combination of different optical modalities (DCS) for accessing non-invasively new info

Acknowledgments

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- Dr. Bruno Germinario



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