Assessment of vascular plasticity in stroke recovery: A NIRS-based metabolic approach

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Background

Brain plasticity in one of the key issue underlying recovery after a stroke.[1] We aimed to study a near-infrared spectroscopy (NIRS)-based approach to assess cortical activation after rehabilitation.

Methods

We enrolled 23 subacute stroke patients (NCT:02267798). Three age-matched healthy subjects were also studied. All participants underwent Fugl-Meyer upper-extremity assessment followed by the NIRS task. NIRS optodes were placed on bilateral motor/premotor cortex[2] and patients were asked to repeat 6-times a reaching and grasping (R-G) task for 15 seconds followed by 45s of rest.[3] The measures were re-administered 6-week later. The changes of oxy-hemoglobin recorded by NIRS during each R-G with the paretic arm were quantified as area under-the-curve (AUC), for the whole brain and for both affected (AFF_{hem}) and unaffected hemispheres ($UNAFF_{hem}$). The metabolic cost (MC), or the oxygen change for a single R-G, was calculated as the ratio between AUC and the number of R-G performed.

Results

The cortical activation during the task assessed by both AUC and MC (Table 1) was:
- higher for stroke patients with respect to healthy subjects;
- inversely correlated with a validated measure, the FM-UE for the AFF_{hem};
- congruently changed following rehabilitation with the FM-UE score variations for whole brain and for the $UNAFF_{hem}$ only.

Conclusions

The R-G NIRS-assisted test was feasible in subacute stroke patients with values correlated with a validated clinical measure at baseline and after rehabilitation. The test, besides confirming the clinical changes following rehabilitation, allows to objectively quantify the contribution of each hemisphere to the recovery process. These preliminary data, with limitations derived from NIRS technology, need to be further analyzed and confirmed.

References

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Table 1. Correlation between the different parameters under study.

	Parameter	Reference	Values	
AUC	Brain	Healthy population	*Stroke*: 213.670±102.923	
			Healthy: 26.793±8.962	P<0.001
MC	Brain		*Stroke*: 136.126±117.773	
			Healthy: 16.446±3.305	P<0.001
AUC	Brain	FM-UE	r= −0.31; P=0.16	
	AFF_{hem}	Scale score	r= −0.44; P=0.038	
	$UNAFF_{hem}$		r= −0.06; P=0.79	
MC	Brain		r= −0.54; P=0.003	
	AFF_{hem}		r= −0.74; P<0.001	
	$UNAF_{hem}$		r= −0.36; P=0.09	
AUC	Δ Brain	Δ FM-UE	r= −0.43; P=0.042	
	Δ AFF_{hem}	Scale score	r= −0.11; P=0.65	
	Δ $UNAFF_{hem}$		r= −0.50; P=0.021	
MC	Δ Brain		r= −0.57; P=0.018	
	Δ $AFFhe_{hem}$		r= −0.27; P=0.17	
	Δ $UNAFF_{hem}$		r= −0.61; P=0.003	

AUC, area-under-curve; MC, metabolic cost; FM-UE, Fugl-Meyer upper-extremity; AFF_{hem}, affected hemisphere; $UNAFF_{hem}$, unaffected hemisphere.