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Functional and structural connectivity in the brain associated with depression after stroke: A longitudinal cohort study

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Background

- Depression is common after stroke
- Independent determinant of handicap and negative impact on outcome and rehabilitation
- Reliable neurobiological correlates are not well established (Noonan et al., 2013)
- Interruption of limbic-cortical, cortico-striatal and default mode network has been implicated in clinical depression but has not been systematically investigated post-stroke

Aim

Characterise the association between depression and interruption to functional and structural brain networks in a longitudinal cohort of stroke survivors.

Hypotheses

- Depressive symptoms will be associated with functional connectivity in the putative depression network at 3 and 12 months post stroke
- Modelling the disconnection of key cortical and subcortical structural brain networks due to the ischemic brain injury may be used to predict post stroke depression (PSD).



Stroke Cohort





Method

- Stroke with and without depressive symptoms
- Depressive symptoms using MADRS SIGMA
- Advanced imaging and clinical at 3 months and 12 months post-stroke
- Functional connectivity (n=50 and n=32)
 - of putative depression network
 - resting state, 3 Tesla, fMRI, 7 min, TR=3.0
- Structural connectivity (n=25 @ 12 months)
 - interruption to white matter fibre tracts
 - Probabilistic prediction: 41 age-matched healthy controls
 - > DWI, HARDI EPI, 60 directions, 3000 s/mm², tractography

Method: Functional Connectivity

Meta-analysis: Activation Likelihood Estimation

Functional Connectivity: Seed-based approach



Putative Depression Regions > Seeds

Emotion Cognition Restingstate



'SEED' REGION





CORRELATED NETWORK





Method: Interruption to WM tracts



Results

Variable	Stats	3 month Sample	12 month sample
Sample size - FC	N=	N=50	N = 32
Age (years)	Mean (SD)	67 (14)	65 (15)
Gender	M/F	36/14	24/8
Depressive symptoms	MADRS (0-60) range	0-26	0-26
-no dep (<7)	N (%)	31 (62%)	19 (59%)
-mild dep (<u>></u> 7-17) major dep (>17)	N (%)	19 (38%)	13 (41%)
NIHSS (1-42)	Mean (SD)	1.0 (1.4)	1.0 (1.3)
mRS (1-5)	Median (IQ)	1 (0-2)	1 (0-1)

Functional connectivity: correlation with depression seeds at 3 months



N = 32

Nil significant

Functional connectivity: correlation with depression seeds at 12 months



Interruption to WM tracts: Network disconnections: Stroke 1









MADRS = 20

Network disconnections: Stroke 2







Disconnections 7.000 6.000 5.000 4.000 3.000 2.000 1.000 0.000

Interruption to WM tracts: Group

12 months (n=25): Disconnectivity of right thalamus



Prediction accuracies of PSD for the stroke patient cohort.

Conclusion

- Depressive symptoms associated with functional connectivity at 12 months, to cerebellum, cuneus, putamen and precuneus: outside putative limbic-cortical network, but linked with striatal and DMN
- Post-stroke depressive symptoms may be predicted from white matter tract disconnectivity models: thalamus disconnectivity highly correlated

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