Functional brain network and trail making test changes after major surgery and delirium

FL Ditzel MD[1]* SJT van Montfort PhD[1]* LM Vernooij PhD[1,2] IMJ Kant PhD[1] E Aarts[1,3] CD Spies MD, PhD[4] J Hendrikse MD PhD[5] AJC Slooter MD PhD[1,6] E van Dellen MD, PhD[1,7] On behalf of the BioCog Consortium *Both authors contributed equally

Department of Intensive Care Medicine, UMC Utrecht, Utrecht, The Netherlands Department of Anaesthesiology, Charité Universitätsmedizin Berlin, Berlin, Germany Department of Radiology, UMC Utrecht, Utrecht, University, Utrecht, The Netherlands Department of Psychiatry, UMC Utrecht, Utrecht, The Netherlands

Background

- Delirium is a frequent complication after surgery in older adults, associated with an increased risk of long-term cognitive impairment and dementia.[1]
- Disturbances in functional brain networks were previously reported during delirium.[2]

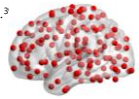
Hypotheses

- Alterations in functional brain networks persist after remission of postoperative delirium (POD).
- Functional brain network alterations are associated with long-term cognitive impairment.

Methods

- Prospective multicentre longitudinal observational cohort study.
- Patients underwent the Trail Making Test B (TMT-B) and resting-state functional magnetic resonance imaging (rs-fMRI) before and 3 months after surgery.
- Delirium was assessed on the first 7 postoperative days.

Figure 1 The power atlas containing 264 putative functional areas.[3] Minimum Spanning Tree (MST) network backbones were extracted on a correlation matrix (264x264). Rs-FMRI functional connectivity strength was calculated by averaging the connectivity values of all connections in the MST.



Results

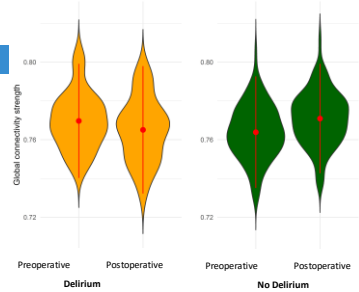
	Total (N=246)	No delirium (N=208)	Delirium (N=38)	p
Female	85 (34.6)	68 (32.7)	17 (44.7)	0.211
Age	71 [68, 74]	70.5 [68, 74]	73 [69.25, 75]	0.050
MMSE	29 [28, 30]	29 [28, 30]	28.50 [27, 30]	0.063
TIA or stroke	89 (36.2)	74 (35.6)	15 (39.5)	0.782
Surgery duration, in min	153 [94, 247]	139 [89, 224]	248 [160, 335]	<0.001
Length of hospital stay, in days	5 [3, 8]	4 [2, 7]	9.50 [6, 15]	<0.001
TMT-B baseline (in sec)	90 [73, 120]	89 [72, 117]	104 [74, 127]	0.215
TMT-B, follow-up (in sec)	85 [70, 112]	83 [69, 110]	95 [81, 117]	0.123

Table 1 Characteristics of the study population

Main finding

Figure 2 Violin plots of Rs-FMRI functional connectivity strength preoperatively versus three months postoperatively for the delirium-(N=38) and the no delirium group (N=208). Rs-fMRI functional connectivity strength increased three months after surgery in the total study population but decreased after POD.

	Rs-fMRI functional connectivity strength		
	β	95% CI	p
Time	0.006	(0.001-0.011)	0.013
Time*delirium	-0.015	(-0.028--0.002)	0.023



Results

- Of the 554 enrolled patients, 246 remained after strict motion correction, of whom 38 (16%) developed POD.
- Patients with decreased functional connectivity strength declined in TMT-B scores compared to those that did not (β=11.04, 95%CI=0.85 - 21.2, p=0.034).
- Rs-fMRI functional connectivity strength increased three months after surgery in the total study population but decreased after POD **(Figure 2)**.

Conclusions

- Delirium was associated with decreased functional connectivity strength after three months
- Decreased connectivity strength was associated with cognitive deterioration
- Delirium may have a long lasting impact on functional brain networks

References

1. Marcantonio ER N Engl J Med. (2017)
2. van Montfort SJT et al. NeuroImage Clin. (2018)
3. Xia M et al. PLoS One (2013)

Funding: FP7, ZonMW & H2020

More information: f.l.ditzel-2@umcutrecht.nl