A Whole-Brain Network Analysis in Patients With Hereditary and Acquired Peripheral Neuropathy

Maria A. Rocca[1], Paola Valsasina[1], Raffaella Fazio[2], Stefano Previtali[2], Elisabetta Pagani[1], Andrea Falini[3], Giancarlo Comi[2], and Massimo Filippi[1]

[1]Neuroimaging Research Unit, Institute of Experimental Neurology, San Raffaele Scientific Institute and Vita-Salute San Raffaele University, Milan, Italy, Italy, [2]Department of Neurology, San Raffaele Scientific Institute and Vita-Salute San Raffaele University, Milan, Italy, Italy, [3]Department of Neuroradiology, San Raffaele Scientific Institute and Vita-Salute San Raffaele University, Milan, Italy

Introduction. The assessment of functional connectivity (FC) at resting state (RS) has demonstrated the presence of functionally relevant RS networks (RSNs) [1]. RS FC in patients with peripheral neuropathy (PN) has not been investigated yet.

Objectives. To assess RS FC abnormalities within and among RSNs in patients with acquired (A) and hereditary (H) PN, as well as their correlation with structural damage and clinical variables.

Methods. RS functional MRI and diffusion tensor (DT) MRI data were acquired from 13 APN, 12 HPN patients and 18 healthy controls (HC). Tract-based spatial statistic (TBSS) analysis [2] was performed on DT-MRI data. Independent component analysis (ICA) [3] was used to identify functionally relevant RSNs. Between-group FC comparisons and correlations with structural MRI and clinical variables were performed using SPM8 and biological parametric mapping (BPM) [4]. The Functional Network Connectivity (FNC) toolbox [5] was used to assess differences of interactions among RSNs.

Results. TBSS analysis detected significant DT MRI abnormalities in the corpus callosum (CC) and optic radiation (OR) of PN patients *vs.* HC. RSNs of interest included two sensorimotor RSNs, two visual RSNs, one auditory RSN, the default mode network (DMN), the executive control network (ECN), the salience network (SN), and two working memory networks (WMN). Compared to HC, PN patients had RS FC abnormalities in the majority of sensory and motor RSNs, with increased FC in the auditory RSN and decreased FC in the secondary visual RSN in all PN (more pronounced in APN than in HPN patients). Decreased FC in the motor RSN was also found in APN patients. FC abnormalities of sensory and motor RSNs were moderately correlated with disease duration, as well as with CC and OR structural damage. Functional abnormalities also involved cognitive RSNs, with decreased FC in the DMN, left WMN and SN in APN and increased FC in the SN in HPN (Figure 1A and 1B).

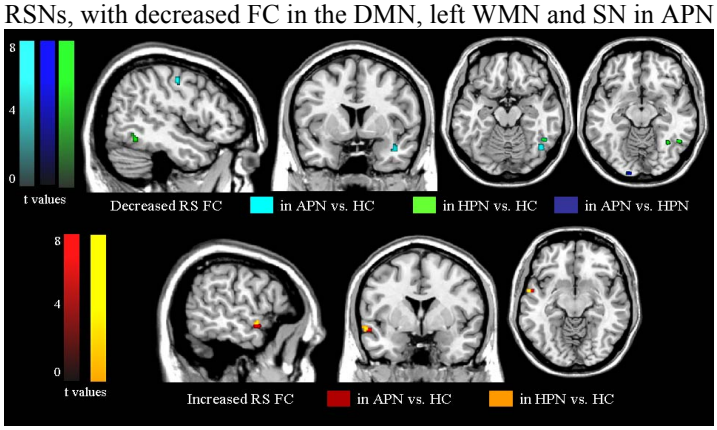

Figure 1A legend. *Between-group differences of RS FC in sensory and motor RSNs among PN patients and HC. Light blue: decreased FC in APN vs. HC; Blue: decreased FC in APN vs. HPN; Green: decreased FC in HPN vs. HC; Red: increased FC in APN vs. HC; Yellow: increased FC in HPN vs. HC.*

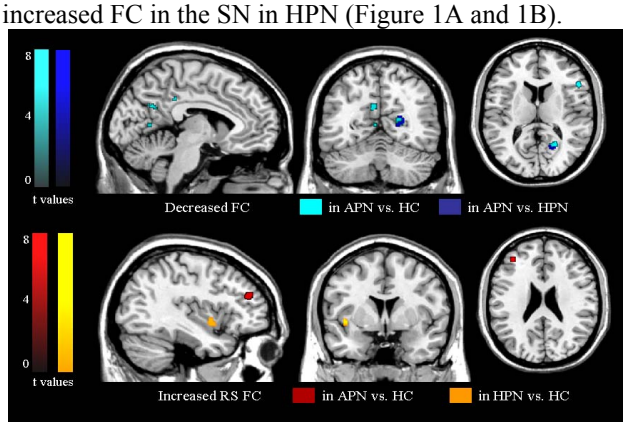

Figure 1B legend. *Between-group differences of RS FC in cognitive RSNs among PN patients and HC. Light blue: decreased FC in APN vs. HC; Blue: decreased FC in APN vs. HPN; Red: increased FC in APN vs. HC; Yellow: increased FC in HPN vs. HC.*

FNC analysis revealed increased inter-network connectivity in PN patients *vs.* HC, mainly involving sensory and motor RSNs. FNC increase was more marked in HPN than in APN patients (Figure 2).

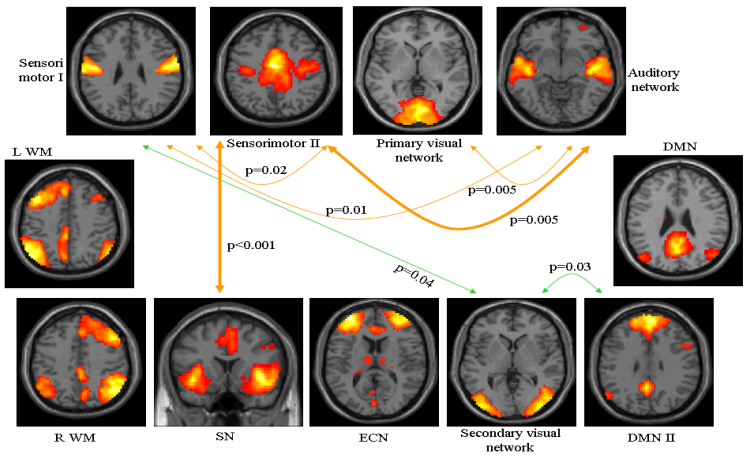

Figure 2 legend. *Between-group differences of FNC among HC, APN and HPN patients. Green arrows: increased FNC in APN patients vs. HC; orange arrows: increased FNC in HPN patients vs. HC (orange arrows in bold refer to connections increased not only vs. HC, but also vs. APN patients).*

Conclusions. RS analysis revealed diffuse RS FC abnormalities in PN patients, which extended beyond the sensorimotor network. Increased FNC among sensory networks is likely to reflect the presence of cross-modal plasticity phenomena among sensory modalities in patients with peripheral damage.

References. [1] Biswal B et al., PNAS 2010;107:4734-39. [2] Smith SM et al., Neuroimage 2006;31:1487-505. [3] Calhoun V et al., Hum Brain Mapp 2001;14:140-151. [4] Casanova R et al., Neuroimage 2007;34:137-143. [5] Jafri M et al., Neuroimage 2008;39:1666-81.