Event -related fMRI in the study of pathogenesis of paroxysmal trigeminal nevralgias:a case study

V. Blasi[1], A. Bizzi[2], M. Leone[3], A. Franzini[4], D. D'Amico[3], A. Falini[1], G. Bussone[3]

[1]Neuroradiology, Università Vita-Salute San Raffaele, Milano, Italy, [2]Neuroradiology, Istituto Neurologico Besta, Milano, Italy, [3]Neurology, Istituto Neurologico Besta, Milano, Italy, [4]Neurosurgery, Istituto Neurologico Besta, Milano, Italy

Purpose of the study: to determine wheter event-related functional magnetic resonance (fMRI) is a suitable tool to determine the cortical and/or subcortical brain structures involved in the pathogenesis of paroxysmal facial pain.

Background: Pathogenesis of paroxysmal facial pain and headache is still largely unknown. Some authors[1-2] hypothesize a role of the central nervous system related to abnormal neuronal activity within focal areas of the mesencephalon and the midbrain hypothalamic junction including the locus coeruleus, red nucleus, posterior hypothalamus and cerebellum with dentatorubrothalamic pathway.

Case history: A 64 y-o lady presented with a 14 years history of frequent episodes of severe stabbing pain in right orbital region lasting 2-120 seconds. The pain episodes were accompained with intense ipsilateral tearing, conjunctival injection and nasal obstruction, and were often triggered by mechanical stimuli such as chewing, talking and moving the neck. She experienced many episodes per hour, usually more than 100 attacks per day (mean 70 per day), occuring both during the day and during the night.

A clinical diagnosis of short-lasting unilateral neuralgiform pains with conjunctival injection and tearing (SUNCT) was made.

Her medical hystory was unremarkable except for mild arterial hypertension. Physical and neurological examinations revealed no abnormalities. CT and MRI scan of the brain and orbit did not reveal any abnormality.

Prophylactic treatment with carbamazepine, gabapentin and lamotrigin was not able to prevent pain attacks. Partial and temporary benefit was obtained with topiramate and valproic acid at high doses. No benefit could be observed with NSAIDs.

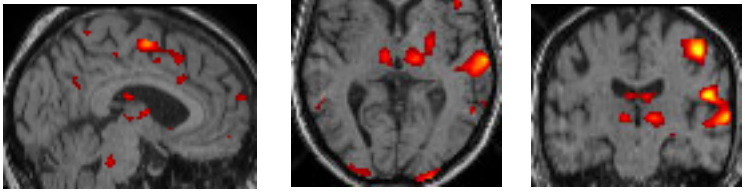
Methods: The patient has been investigated with event-related fMRI consisting of 6 runs of 80 volumes each during which the patient was asked to press a button at facial pain onset and cessation. The botton press determined a noise detectable from outside the scanner and allowed us to record at which volume it occurred.

FMRI was performed on a 1.5 T Philips Intera scanner, with single shot EPI sequence (matrix 64x64, FOV 240 mm, echo-time 60, flip angle 90°, TR 3000). FMRI data were analysed with SPM2 software (http://www.fil.ion.ucl.ac.uk/spm) according to the general linear model with an event-related paradigm. Images processing included motion correction, spatial normalization in a standard stereotactic space and smoothing (FWHM 8 8 8 mm). Statistical maps were created with a cross-correlation of data with a model including hemodynamic responce function and time derivative. Data were thresholded with a p value<0.001 and multiple comparisons corrected ($p<0.05$).

Results: FMRI data showed activation in the left cerebellum, in the right vermis , right middle temporal gyrus (BA37), left superior and inferior temporal gyrus (BA22), right and left medial thalamus and hypothalamus, left lenticular nucleus, left precentral gyrus, anterior cingulate and SMA.

Conclusions: event-related fMRI allowed us to determine a complex pattern of brain activity including bilateral thalamus and posterior hypothalamus. These data are in agreement with a previously reported case of SUNCT [2] investigated with a block design fMRI and with theories of the pathogenesis of this syndrome for which hypothalamic dysfunction may play a crucial role.

Furthermore, we observed a complex network including primary motor area, anterior cigulate and SMA involved in the execution of the botton press to signal onset and offset of pain attacks.



References:

1) A. May et al. 1998, The Lancet, Vol 352 No 25, 275-78

2) A. May et al. 1999, Annals of Neurology, Vol 46 No 5, 791-794.*