

PUDENDAL NERVE BRAIN MAPPING IN HEALTHY SUBJECTS: PROPOSAL OF A NEW NEUROPHYSIOLOGICAL TOOL FOR THE FUNCTIONAL EVALUATION OF CNS.

Hypothesis / aims of study

The precise identification of the anatomical cerebral structures involved in micturition can contribute to a better understanding of the control of urine storage and micturition and the development of therapeutic models. Functional brain evaluation of central nervous system (CNS) using PET and fMRI offers a powerful but expensive tool for the non-invasive localization of sensorimotor areas involved in micturition.

It's well known that the general principle for neuromodulation in the urogenital area is to activate artificially normal detrusor inhibitory reflexes. The inhibitory effect on the urinary bladder is mediated by the activation of pudendal afferents, resulting in direct inhibition of the pelvic nerve outflow via the Onuf's nucleus and also by cortical inhibition as shown recently by Jiang¹ et al. State-of-art literature doesn't provide any information about cortical representation of pudendal nerve afferents using non invasive functional brain imaging tools such as PET or fMRI. Aim of this study is to present a non invasive neurophysiological tool for the functional cortical representation of somatosensory brain areas² arising from pudendal afferents during bladder filling in healthy volunteers.

Study design, materials and methods

15 healthy adult, right and left handed volunteers (5 males and 10 females, mean age 40.7 years - range 25 – 56 -) were recruited from personell working at our hospital. None reported any urological, neurological or anorectal problems and all gave an informed written consent before the study.

The study was carried out evaluating the pudendal afferent pathway to the CNS by means of somatosensory evoked potentials (SEPs) analysed with a dedicated brain mapping software. SEPs supply the electrical evidence of how the brain receives and responds to external stimuli, thus providing an objective measure of the somatosensory system function.

The software is able to create a topographical cerebral mapping (functional cerebral mapping) combining this function with the visualisation and incorporation of morphological informations obtained from MRI or CT.

Data for the functional cerebral mapping (FCM) were obtained analyzing the long latencies of pudendal SEPs during driven bladder filling with 20 mg of furosemide, recording pudendal SEPs at time 0 (void bladder), at time 1 (first desire to void) and at time 2 (urgency to void) and measuring the bladder filling at each time by means of a Bladder Scanner. At the beginning of the examination each patient underwent a short latency pudendal SEP on each side and a right tibial SEP for functional evaluation of sensory peripheral afferents. Cerebral brain mapping of long latency pudendal SEPs was performed with 19 electrodes fixed on the scalp with collodion.

Results

One patient's data were not evaluated due to artefacts in the traces. Consistent and replicable pudendal latency peaks were recorded for each patient at every examination time. Some of these peaks are well known, up to N72: the others were named according to mean latency and polarity (N or P).

Cerebral maps related to these peaks revealed the same topographical distribution of brain evoked electrical activity in each subject. We didn't find significant latency difference comparing data with void or filled bladder.

Analysis of topographical maps revealed a precise pattern of evoked response distribution through the brain regions (Fig. 1), travelling from the medium parietal area (contralateral to

the stimulus) - P40, N50 - to the mid anterior areas - P60, N72 - then moving to the mid anterior areas ipsilaterally - P100, N126 - to arrive in frontal regions - P200, N260 - . Diffuse activation of all brain areas appeared from P300 to N450 peaks.

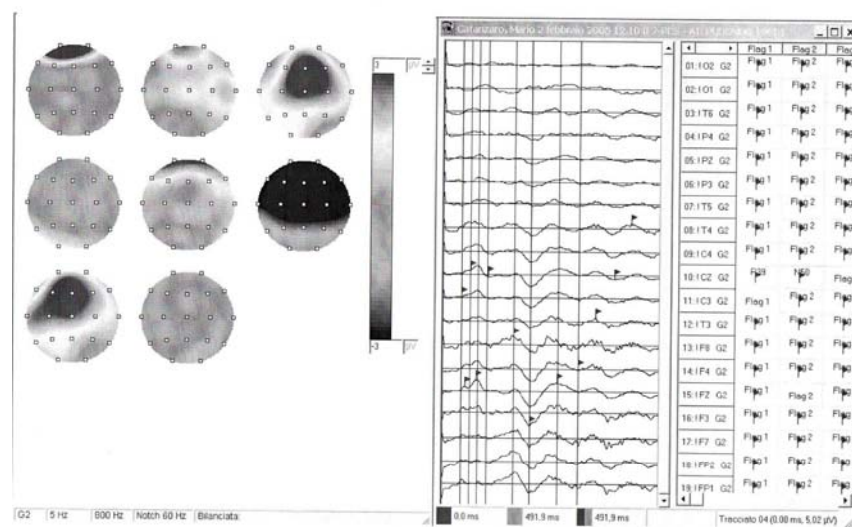


Fig. 1 – Cerebral functional mapping of a healthy right handed subject .

Interpretation of results

In our paper we present a simple, less expensive and non-invasive tool to explore cerebral areas involved in pudendal stimulation during bladder filling. We can compare in different patients a topographical cerebral mapping based on a neurophysiological examination, combining this function with the visualisation and incorporation of morphological informations obtained from MRI or CT.

Concluding message

The future application of this diagnostic tool could be the ability to detect differences in cerebral responses, in normal and pathological patients, in the sensory areas arising from pudendal afferents. The role of this diagnostic procedure could be a brain functional evaluation in patients affected by dysfunctional urinary and fecal symptoms.