Clinical Neurophysiology 119 (2008) 1795–1802

www.elsevier.com/locate/clinph

The effect of aging on auditory components of event-related brain potentials

Sami Schiff[a,b], Pietro Valenti[a,b], Pellegrini Andrea[a,b], Maria Lot[a,b], Patrizia Bisiacchi[b,c], Angelo Gatta[a,b], Piero Amodio[a,b,*]

[a] *Department of Clinical and Experimental Medicine, University of Padua, Via Giustiniani, 2, 35128 Padua, Italy*
[b] *CIRMANMEC, University of Padua, Italy*
[c] *Department of General Psychology, University of Padua, Italy*

Accepted 7 April 2008
Available online 20 May 2008

Abstract

Objective: To describe auditory perceptual, pre-attentive, attention-related and cognitive processes along lifespan in normal people by a simple auditory oddball paradigm easily usable in clinical practice.
Methods: ERPs were recorded in 72 normal subjects. Four blocks of tones were delivered (20% rare 2000 Hz and 80% frequent 1000 Hz). In the former two blocks, subjects performed a concomitant distracting visual search task (distracted condition); in the latter two blocks, they had to attend the occurrence of the rare tones (active condition). Latency and amplitude of ERPs were analyzed according to age, gender, educational level and repetition.
Results: N100 amplitude was greater in active than in distracted condition. MMN amplitude decreased with age. N2b and P300 latencies increased with age, while their amplitudes decreased. Females produced greater P300 than males. In the elderly, P300 latency was found to be longer in the second block than in the first one.
Conclusions: N100 and MMN were found to be less affected by age than N2b and P300. When repeated, P300 showed increased latency in elderly subjects.
Significance: The protocol detected the higher influence of aging on late cognitive processes than on the perceptual and pre-attentive ones. Age-adjusted normative data were produced.
© 2008 International Federation of Clinical Neurophysiology. Published by Elsevier Ireland Ltd. All rights reserved.

Keywords: ERPs; Aging; Auditory oddball; P300; MMN; N100; N2b; Attention

1. Introduction

The study of age-related cognitive changes is becoming an important scientific and social issue, due to the prolonged life expectancy of the human population and the consequent need of an early discrimination between normal and pathological brain aging for precocious treatment of cognitive alterations and dementia (Salthouse, 1991; Golob et al., 2002; Katada et al., 2004).

Event-related brain potentials (ERPs) provide important clues to understand normal and abnormal brain aging, because they reflect the time-course of perceptual, attention-related, and cognitive process before their behavioural manifestation (Rugg and Coles, 1995). Of the tasks used to evoke ERPs components, the auditory oddball paradigm is one of the most suited for both experimental and clinical investigation (Squires et al., 1976; Duncan-Johnson and Donchin, 1977; Verleger et al., 1991; Polich et al., 1985; Polich, 1987a,b, 2004a, 1991, 1996, 1998, 2004b; Chapman et al., 2007), since it generates a series of well-characterized components reflecting different stages of auditory processing. In the oddball task, subjects are exposed to a sequence of visual or auditory stimuli in which a small amount (usually

* Corresponding author. Address: Department of Clinical and Experimental Medicine, University of Padua, Via Giustiniani, 2, 35128 Padua, Italy. Tel.: +39 049 8218675; fax: +39 049 8754179.
E-mail address: piero.amodio@unipd.it (P. Amodio).

1388-2457/$34.00 © 2008 International Federation of Clinical Neurophysiology. Published by Elsevier Ireland Ltd. All rights reserved.
doi:10.1016/j.clinph.2008.04.007

15% or 20%) of deviant stimuli (oddball), differing from standard stimuli, is randomly presented (Polich, 2004a). Subjects may be invited to perform a distracting task and to listen passively to the sequence of standard and deviant stimuli (distracted condition), or to pay attention to the occurrence of deviant stimuli inserted in the sequence of standard stimuli (active condition). In these two conditions target stimuli evoke different sequences of ERP components (Kok, 2000).

Both distracted and active conditions evoke a first negative deflection, named N100, reflecting the activation of the secondary auditory cortex (Picton, 1988; Mangun and Hillyard, 1995). This component, reflecting the obligatory activation of perceptual processes (Picton, 1988), shows an increased amplitude in the active task due to an attention-related facilitator mechanism that increases the amount of sustained resources necessary for processing the incoming stimulus in a task-related manner (Mangun and Hillyard, 1995).

The *Mismatch Negativity* (MMN – Näätänen et al., 1978, 1982; Näätänen, 1992; see Näätänen et al., 2005 for a review), which is evoked both in distracted and active tasks, reflects a comparator mechanism of sensory memory (echoic memory) that automatically and unconsciously stores a short-living non-semantic representation of the physical features of the stimuli (Cowan et al., 1993).

Another negativity, which is greater than MMN, named N2b, is evoked in the active task (Kok, 2000). This latter component overlaps the MMN so that, in the active condition, the MMN is usually masked by the averaging procedure (Pekkonen et al., 1996). The N2b evoked in the active task reflects selective endogenous mechanisms involved in the detection of task-relevant characteristics of targets (Näätänen et al., 1982; Mangun and Hillyard, 1995; Amenedo and Diaz, 1998).

The most extensively studied component evoked by the active oddball task is the parietal P300 or P3b (Kok, 2000; Polich, 2004a). One of the functional rules attributed to this component is the context-updating of mental representation when a deviant stimulus occurs and it matches with the mental representation of the task-relevant stimulus (Donchin, 1987; Polich, 2004b). P300 latency represents the time needed to stimulus categorization and its amplitude seems to be related to the magnitude of the transient attention-related resources recruited for the execution of the task (Kok, 2000).

Therefore, the study of all these components, that can be easily evoked by an *ad hoc* paradigm, provides a tool usable to define the profile of auditory perceptual, preattentive, attention-related and cognitive processes.

Previous results on the effect of aging on these ERP components, obtained by various paradigms and different settings, report that (i) N100 is not affected by age (e.g., Bahramali et al., 1999), at least in the active task (ii) MMN amplitude, but not its latency, decreases with age (Cooper et al., 2006; Pekkonen et al., 1996) (iii) N2b (Amenedo and Diaz, 1998) and P300 latencies increase with age in contrast with their amplitude that decreases along the lifespan (Polich, 1996).

Despite many papers concerning such effects, a complete description of the spectrum of components elicited by the same rare stimulus in both active and distracted tasks in a well-balanced group of normal subjects is lacking.

Therefore, the present study aims at (1) proving that a single simple *ad hoc* eliciting procedure can be used (i) to investigate age-related variations of ERP components elicited by auditory oddball paradigm in normal people and (ii) to improve insight into the cognitive features of normal aging (Polich, 1998), taking into account gender, education level and task repetition (2) producing normative values usable in clinical practice.

2. Patients and methods

2.1. Subjects

A convenient sample of 72 ambulant normal subjects was planned for the study. The sample was balanced so that it should comprise 10–12 subjects in each of the 6 decades of age between 20 and 80 years (20–29, 30–39, 40–49, 50–59, 60–69, 70–80 years), homogeneously distributed for gender in each decade. Four subjects (2 females and 2 male) were subsequently excluded for further analysis because their ERPs showed too many artefacts and/or eye blinks. Therefore, 68 subjects were used for data analysis (median age 55.5 years, interquartile interval 30.5 years – Table 1).

The subjects underwent a complete standard ambulatory clinical assessment and provided all past documents concerning health status. Respiratory, renal, liver, heart, neurological or psychiatric diseases on clinical history or routine clinical examination were considered exclusion criteria, as well as history of psychotropic drugs or alcohol abuse (>40 g/day for males and 20 for females), hearing loss (no significant audiometric alteration), lack of consent or unwillingness/inability to comply with the test procedures. An additional exclusion criterion was a Mini Mental State Examination (Folstein et al., 1975) lower than 27.

Ethical clearance to the study was obtained by the local Hospital Authority; all subjects involved in the study provided informed written consent.

2.2. Stimuli and procedure

The auditory stimuli used in the present study were the same both for distracted and active tasks. Standard stimuli were 1000 Hz tones, and deviant stimuli were 2000 Hz tones (both with 5 ms rise/fall time, 110 dB SPL, 50 ms duration). The sequence of stimuli was presented biaurally with an inter-trial interval varying randomly in each trial from 1200 to 2500 ms. Target stimuli were presented in a pseudo-randomized manner inside the standard tone sequence with 20% probability.

All subjects underwent 4 blocks of 200 stimuli (160 standard and 40 target tones). In the first two blocks (distracted

Download English Version:

https://daneshyari.com/en/article/3047747

Download Persian Version:

https://daneshyari.com/article/3047747

Daneshyari.com