PATTERN REVERSAL VISUAL EVOKED POTENTIALS IN MIGRAINE ARE ALTERED AT HIGH SPATIAL FREQUENCY

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Objective

Visual symptoms and photophobia are common features of migraine, but are not exclusively confined to attacks. Hypersensitivity to light and specific gratings (Coleston *et al,.* 1994) was found even in the migraine-free interval. This might be due to affection of two visual pathways in migraine, which has been proposed previously (Diener *et al.,* 1989). The Y system (magnocellular pathway) is very contrast sensitive (Kubová *et al.,* 1995) and processes movement and luminance. The X system (parvocellular pathway) requires higher luminous intensities and processes contrast and contour.
Luminance- and contour processing pathways can be investigated by means of pattern-reversal visual evoked potentials (VEPs) using different check sizes. Large patterns (i.e. low spatial frequency, 0.5 and 1 cpd) are mainly conducted by the Y system, whereas for small patterns (2 and 4 cpd) both the X system and the Y system are involved (Kulikowski, 1978). Until now, all VEP studies in migraine patients were performed using only a single check size for stimulation. The aim of the present study was to clarify the affection of the two visual pathways in migraine by means of pattern reversal VEP at four different spatial frequencies.

Methods

Components of pattern-reversal VEPs were compared between young adult migraineurs (n=26) and healthy volunteers (n=28) in the headache-free interval. 13 had migraine without aura (MO, code 1.1) and 13 had migraine with aura (MA, code 1.2, Headache Classification Committee, 1988). Patients were included who reported having episodes of migraine headaches for at least two years (mean±SD 17.1±6.9 years) and suffered at least 2 attacks per month in the last quarter year. Only subjects reporting no recurrent migraine-like headaches or ongoing medication were included into the control group.
Black-and-white checkerboard patterns (contrast >99%, reversal frequency 1 Hz) were binocularly presented, spatial frequencies (0.5, 1, 2, and 4 cpd) were applied in increasing order, i.e. proceeding from large to small checks. Statistical analysis was carried out with SPSS for windows, version 7.4. Results were compared by analysis of variance (MANOVA) for repeated measures. Subjective ratings were compared using non-parametric tests (Kruskal-Wallis test, Mann-Whitney U test). The alpha-level was set to 0.05.

Results

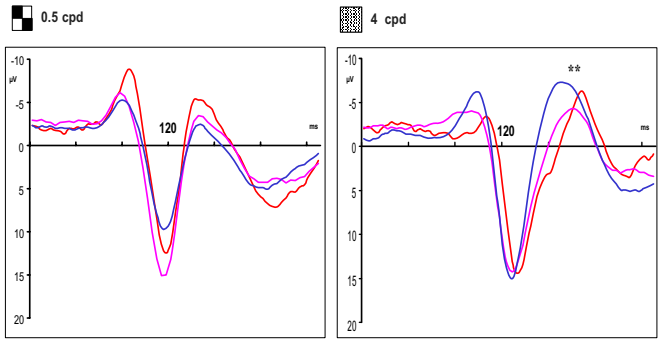

Figure 1:

Grand means of VEP recordings at 0.5 and 4 cpd in migraine with aura (MA, red line), migraine without aura (MO, pink line) and controls (CO, blue line).

Observed differences were dependent on VEP spatial frequency. Grand means of the VEP recordings are presented in Figure 1. Only at high spatial frequency (2 and 4 cpd) N2 latency was significantly prolonged in migraineurs. At 4 cpd (group differences p<0.001), latency prolongation was most pronounced in MA patients (first block 186.8±2.5 ms) but also found in MO patients (first block 178.2±5.3 ms) when compared with controls (first block 167.1±2.2 ms). N2 latency at the smallest check-size was longer than 172 ms in 80.7% of migraineurs but only in 21.5% of controls (p<0.001, Figure 2). N2 latencies at low spatial frequency (0.5 and 1 cpd) were not significantly different between groups.

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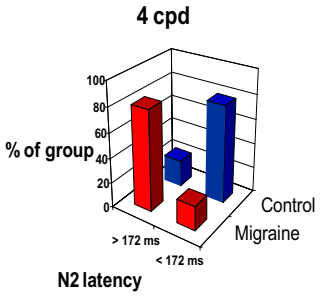

Figure 2:

Frequency of prolonged N2 latency (> 172 ms at 4 cpd) in migraineurs and controls (p<0.001).

Conclusion

Migraineurs have prolonged N2 latencies when small checks are applied, no differences were found at low spatial frequencies, i.e. when large check sizes were used. VEP parameters vary as a function of check size. N2 at low spatial frequencies is ascribed mainly to the Y system (N180). N2 at high spatial frequencies is a superposition of an earlier contour specific component called N130 and N180. In migraineurs, delayed N2 latency at high spatial frequencies may be due to an attenuated or absent N130 and/ or a relatively predominant N180 (Figure 3). This might reflect an imbalance of the two visual pathways with relative predominance of the luminance-dependent Y system.

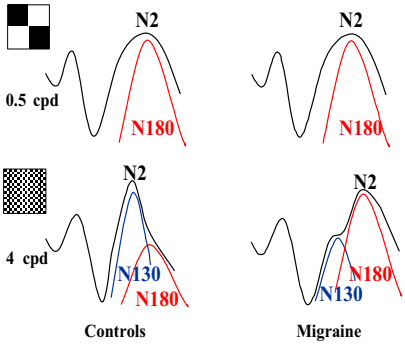

Figure 3:

Model of VEPs at low (0.5 cpd) and high spatial frequency (4 cpd). N2 at high spatial frequency can be regarded as a superposition of N130 and N180 with strong predominance of N130 in normal subjekts. In migraineurs, attenuation or lacking of a contour-specific N130 may cous a delayed N2 consisting mainly of the luminance-dependent N180.

Current investigations:

Prolonged N2 latency at high spatial frequency may be useful as an additional objective criterion in migraine. It is currently investigated whether differences are specific for migraine and can be already found in childhood migraine. For that VEPs of children and adolescents aged 6-18 yrs. with migraine (n=60), tension headache (n=60) or without headaches (n=60) are investigated.
Preliminary results confirm our findings in adults. In children and adolescents with migraine, N2 latency at high spatial frequency is significantly longer than in healthy controls. But group differences become less marked than in adults, because in young children N2 latency is age-dependent and decreases with increasing age.

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