Larger BOLD responses to visual stimulation in area V1 in people with migraine with aura

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Purpose

In migraine, abnormal visual cortical excitability between headaches could predispose to cortical spreading depression and visual aura.

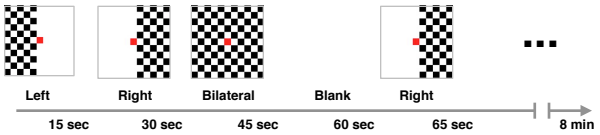
While prior fMRI studies comparing migraineurs with aura (MWA) to controls have shown differences in extra-striate cortex, altered V1 responses to light have not been reported.

Methods

Subject Demographics	MWA	MWoA	Controls
Number (n)	18	18	18
Age (yrs ± SD)	34 ± 6	34 ± 6	34 ± 6
Gender	3 m/15 f	3 m/15 f	3 m/15 f

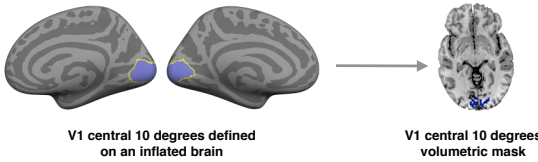
Task: Subjects underwent BOLD EPI at 3 T scanner (160 TRs, 3mm voxels, TR=3 sec) while viewing a 5 Hz flickering checkerboard in a random sequence as shown in Figure 1. Subjects performed an attention task at the fixation dot.

Fig 1



Data Processing: For each subject, V1 was defined anatomically on FreeSurfer inflated surface (Hinds 2008).
A V1 sub-region of interest corresponding to central 10 degrees was created from retinotopic data (VSS 2011 posters 63.324 & 63.326), and a volumetric mask derived.
The lateral geniculate nucleus was defined using the SPM anatomy toolbox in MNI space.

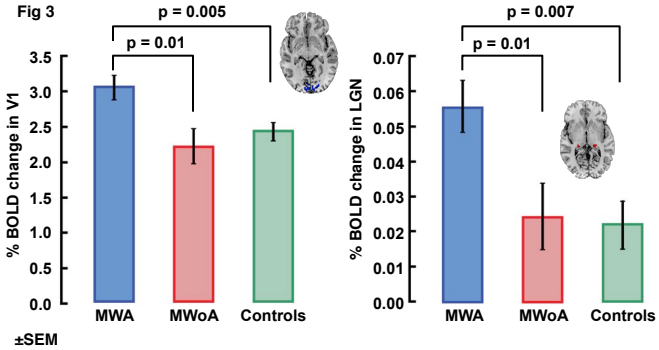
Fig 2



Results

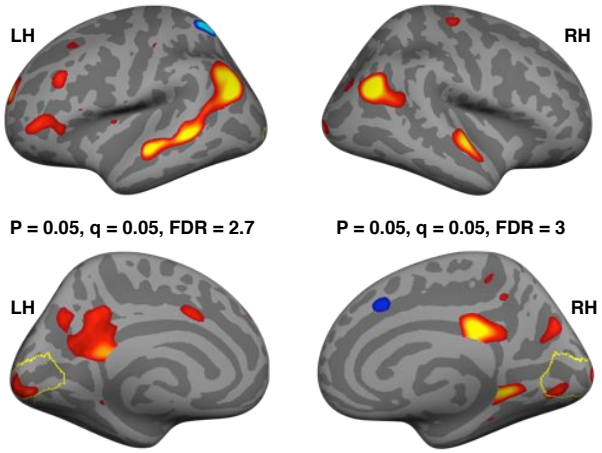
ROI Analyses: The average amplitude of BOLD response was obtained for each subject within the V1-subregion of interest and within an LGN region of interest. Two-tailed t-tests compared the responses between the populations.

Fig 3

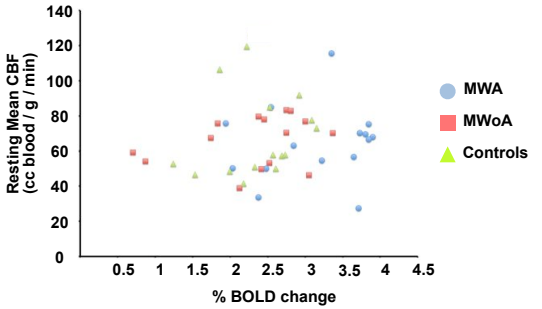


Whole Brain Analysis: The amplitude of BOLD response was mapped onto each subject's inflated surface, aligned to a common average brain and smoothed with a 2-D, 15 mm FWHM kernel. Whole brain random-effects models tested for group differences in BOLD response at each vertex. Additional covariates modeled the effects of age and gender. Permutation analyses and FDRs were used to determine map-wise thresholds.

Fig 4



Relation to perfusion: Could activation differences simply be the result of greater resting blood flow to occipital regions in MWA as opposed to a difference in neural reactivity?



Summary

- Within V1, BOLD responses were significantly larger in MWA as compared both to controls ($p<0.005$) and MWoA ($p<0.01$).
- A similar difference in the LGN was seen as well
- This is likely a neural effect, as no difference in resting blood flow was seen between the groups in visual cortex.
- This effect was specific to patients with aura, as migraine without aura (MWoA) did not differ from controls in any region.

Conclusions

- Consistent with the presumed mechanism of photic sensitivity in migraine, a larger BOLD response to light was seen in patients with aura within area V1.
- Other cortical sites of greater response to light were seen in MWA, including in the cingular gyrus. These may be related to the nociceptive component of photophobia.

Acknowledgements

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References

Hinds OP, Fischl B et. al. (2008) Accurate prediction of V1 location from cortical folds in a surface coordinate system. NeuroImage. 39:1585-99.

http://cfn.upenn.edu/aguirre/wiki/lab_presentations