MECHANISMS OF MIGRAINE AURA REVEALED BY FUNCTIONAL MRI IN HUMAN VISUAL CORTEX

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By Anna Sinova
Migraine

- Migraine is a neurological syndrome, involves altered bodily perceptions, headache and nausea

- Aura:
  - Visual hallucination/illusion
  - Scintillations followed by blind spot
  - Restricted to one visual field
  - Begins in the central vision, spreads into periphery
Background

- Leao (1944): relationship between cortical spreading depression (CSD) and aura
  - Wave of neuronal and glial depolarization followed by long-lasting suppression of neuronal activity in the visual cortex

- Many indirect studies showing several aspects of CSD being associated with aura

- No direct demonstration in human cortex
Materials

- fMRI in humans
  - previously successful in animal research: detected presence of CSD and the rate of CSD propagation
- BOLD signal is mapped onto flattened cerebral cortex in relationship to retinotopy
Experimental Subjects

- 3 males
- Suffer from migraine attacks with aura
- No medication taken
- Total of 5 attacks scanned:
  - 2 – induced in the same subject (P.R)
  - 3 – spontaneous in 2 other patients
Procedure

- Flashing checkerboard was presented
- Squeeze bulb to indicate beginning and end of the visual aura and beginning of headache
- P.R. induced his attacks when necessary
  - Scintillating white noise in L.V.F.
- Other 2 patients, scanned after the aura began
Results

- No aura: normal oscillating activation pattern

- Aura:
  - Marked increase in BOLD response (a)
  - Suppression by light modulation (b)
  - Partial recovery of response to light at decreased BOLD signal (y)
Results

- Retinotopic progression of BOLD was consistent with migration of visual aura
- Visual aura started in V3A in P.R
- The average velocity of spread: 3.5 mm/min
- When the screen was dark, BOLD signal appeared at the onset of aura in V3A
Conclusions

- Aura associated with slowly spreading area of abnormal blood flow in the occipital lobe
- The spread of the BOLD signal during migraine aura closely resembled CSD
- Extrastriate focus, such as V3A – sensitive to motion and luminance contrast
- Physical appearance of the aura might reflect the focus of origin
Application

- Auras are evoked by aberrant firing of neurons characteristic of CSD
- Drugs that inhibit development and propagation of CSD can provide novel treatment for migraine aura
- Future research: relationship between CSD and pain
Thoughts and Comments

- Control subjects: should have included no-aura migraineurs
- Application: CSD targeting drugs that treat migraine preceding aura, do not necessarily treat migraines
Thank you!
Questions?