Reduced thalamocortical input to cortex triggers K-Complexes

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Background
KC are downstates (Cash et al., 2009).

In stage 2 NREM sleep, K-complexes (KC) occur spontaneously or in response to a stimulus.

KC are synchronous across the cortex.

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Example downstates evoked in spontaneously spindling model of stage 2 sleep

I. By directly depolarizing all RE cells in population

II. By stimulating a subset of 6 PY cells projecting to all RE cells

Parametric analysis suggests a critical role of spindle disruption in KC generation

Direct increase of RE firing or increase of RE Vm that disrupts TC & RE spindling decreases the drive of TC on PY, leading to a PY downstate.

Downstates produced spontaneously

Average of 35 spontaneous DS produced during a 20 sec simulation with 15 PY cells projecting to all RE cells. A DS was defined as having less than 10 PY spikes per 100ms for at least 200ms. The start of the averaged DS are shown in T2 and TP but strong in FP. Note the lack of delay from FP to T2 for KC type 2.

Number of spontaneous downstates generated depends on PY to RE strength or number of PY cells projecting to all RE cells

Conclusions:
1. Possible to generate model of stage 2 sleep with spindles as well as spontaneous and evoked KC (DS).
2. Activation of a small part of cortex projecting widely to RE can evoke KC (DS).
3. Spindle suppression in RE and TC cells may be a critical part of the mechanism evoking KC.
4. Spontaneous DS increase with increasing PY to RE strength or number of PY cells projecting to all RE cells.

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