# The role of intrinsic properties and electrical synapses in the generation of rhythmic oscillations in the thalamic reticular nucleus


## Abstract

Neurons of the thalamic reticular nucleus (TRN) interact with the thalamocortical network via synchronized oscillations, yet the mechanisms underlying rhythmic oscillations within individual TRN neurons remain unclear. Through whole cell recordings in the *in vitro* rat slice, I investigated contributions to rhythmicity from intrinsic cell properties and synaptic mechanisms. First, I used bath-applied tetradotoxin (TTX) (1pM) to block sodium channels and measured rhythmicity. I then conducted recordings in the presence of both TTX (1 pM) and (1S, 3R) - l-aminoylcopentane-l, 3-dicarboxylic acid (ACPD) (50 pM), a metabotropic glutamate receptor (mGluR) agonist. The same experiments were repeated, retaining the TTX, but replacing ACPD with meclofenamic acid (MFA) (200 pM), a gap junction blocker. Elimination of fast synaptic transmission revealed oscillations (4-28 Hz), whose intensity and frequency depended upon membrane voltage. The mean membrane potential for peak rhythmicity was -24.75 t 6.53 mV (+ SD), and the mean frequency corresponding to peak rhythmicity was I1.32 x.5.2 Hz (SD). After application of ACPD, there was a statistically significant reduction in the strength of rhythms at depolarized potentials. MFA also significantly diminished the intensity of rhythms at depolarized potentials. These results suggest that intrinsic properties give rise to rhythmic activity, and electrical coupling between neurons further enhances oscillations. Given that the TRN is largely considered the origin of sleep spindles, these rhythmic oscillations, which overlap with the frequency range of sleep spindles (7-l4Hz), may play a role in the generation of spindling activity.